THE UNIVERSITY OF ALBERTA

MANPOWER PLANNING: A CASE STUDY OF LARGE CONSTRUCTION PROJECTS IN ALBERTA (1974-1988)

by

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A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled MANPOWER PLANNING: A CASE STUDY OF LARGE CONSTRUCTION PROJECTS IN ALBERTA (1974-1988), submitted by JOHN PATRICK BYERS in partial fulfillment of the requirements for the degree of Master of Business Administration.

ABSTRACT

Purpose of this thesis is to improve current understanding of the functioning of the Alberta construction labour market and to determine the ability of this market to support simultaneous construction of several large scale petroleum resource development projects.

Review of current literature indicates that regional labour demand-supply problems are generally not a subject of concern by writers in this field. Therefore, the Syncrude project was examined to determine how the labour market actually reacted to the demands of a large project. It was found that the general economic level of the country had a significant effect on labour availability. During the initial planning stages for Syncrude the Canadian economy was very strong and manpower supply forecasts indicated a substantial shortfall. Consequently a strong recruiting effort was planned to secure tradesmen from national and international competitors. However, slackening of the economy in Eastern Canada, during the course of the project, allowed staff levels to be maintained by voluntary migration without the necessity for an extensive recruiting campaign. It was also discovered that a high ration of new hires to average employment levels was required to offset high rates of turnover.

The large projects planned for the near term period

were analyzed to determine construction manpower requirements. Consolidated projections of the number of tradesmen necessary to carry out the planned projects indicates a demand several times greater than Syncrude. This situation is due to simultaneous construction of three large extraction complexes and two major pipeline projects.

Application of Syncrude hiring experience factors to estimated manpower levels generates such a high demand for tradesmen that successful completion of projects as scheduled appears to be in jeopardy. It is recommended that the staged construction principle, of a construction start for an extraction plant every three years, be adopted. This procedure can be regulated by the provincial government through issuance of development permits and will allow orderly and efficient development of tar sands and heavy oil resources.

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TABLE OF CONTENTS

Chapter | Page

Chapter | Page

Chapter		Page
IV	Coal and Steel Projects	86
	Tar Sands Extraction	86
	Heavy Oil Extraction	93
	Natural Gas Pipelines	104
	Alcan pipeline	104
	Polar gas pipeline	108
	Summary	117
	Footnotes	125
V	SUMMARY AND CONCLUSIONS	127
	Introduction	127
	Syncrude Experience	128
	Analysis	130
	Site Conditions Factors	130
	Decentralized pre-assembly facilities	130
	Overtime policy	131
	Construction Labour Market Factors	132
	Edmonton region	133
	Northern Alberta region	135
	Conclusions	141
	Uncontrolled case	142
	Managed case	143
	Controlled case	145
	Recommendations	147
	Productivity	147

LIST OF TABLES

Table		Page

LIST OF FIGURES

"As for men, we are entering a period of an extreme shortage of skilled labour and it is going to be difficult to find men who are prepared to go to Fort McMurray to work on jobs of this kind."

Frank K. Spragins

Former Chairman of the Board

Syncrude Canada Ltd.

In an address to Canadian Industries Limited, Banff, May 9, 1972.

Chapter I

INTRODUCTION

Purpose of the Study

The late Frank K. Spragins was a pioneer in the search for conventional oil deposits in Alberta and the driving force behind creation of the Syncrude Tar Sands enterprise. The following excerpts from two of his addresses illustrate the dependence of our economy on petroleum and the limited options open to Canadians which are the incentives for development of our non-conventional petroleum resources. The reaction of the labour market to demand pressures caused by construction of the massive facilities necessary for extraction of petroleum from new sources is the subject of this thesis.

> Canada and the United States are using a combined total of 12.7 million barrels of liquid hydrocarbons per day. The entire North American economy to a marked degree is bound to this form of energy. To live without large volumes of competitively priced oil would necessitate a complete revamping of the mode of living. While it might be done, it would only be at some sacrifice of economic strength, and the faster the transition, the higher the penalty would be. With an economy geared to oil, there must be a reliable competitive source of oil to insure the health of the economy.
>
> The big question today is when will North America get an abundant future supply of crude oil at competitive prices.[1]

<u>Petroleum supply options</u>. In a speech several years later Spragins defined the options open to Canada as being:

1. Diversify our oil imports so that we have enough sources of supply, in enough countries, that we will be immune to blackmail or artificially imposed oil shortages.
2. Divert present exports of Western Canadian oil to serve Quebec and the Maritimes.
3. Develop indigenous oil reserves in Canada, chiefly synthetic oil from the Athabasca Tar Sands and conventional oil from the Canadian Arctic.[2]

Disadvantages and impracticality of the first two options are obvious. Hedging dependence on Middle East supplies by increasing imports from Venezuela would be expensive as increased demand would force up Venezuelan prices and Canada would likely have to furnish technical and research assistance in support of development of Orinoco basin heavy oil deposits. Diversion of Western Canada exports to the Eastern provinces raises the problem as to how dependent American customers can be shut off without throwing them into real difficulties. The most viable alternative is the third option, development of Canadian indigenous oil reserves. This strategy has been followed over the last decade with active exploration, experimentation and development work being carried out in the frontier areas and in the tar sands and heavy oil deposits.

Present state of the industry. The state of the industry has now advanced to the point where experimental work is well advanced, prototype plants are in production and plans laid for construction of commercial processing facilities. Potential introduction of a massive construction program for energy resource extraction plants concurrent with

other large scale industrial construction projects and natural gas transmission lines has potential for creating pressures in the Alberta construction labour market for skilled heavy construction tradesmen. Concern has been expressed within industrial circles that the simultaneous development of two or more of these "super-projects" will unbalance the construction labour market to the extent that individual projects could be delayed or prolonged with consequent execution inefficiencies and severe escalation of construction costs.

Statements made in a study of the impact of the Syncrude project on the economy of Alberta, conducted by Hu Harries and Associates, illustrate this problem.[3] The study estimated that Syncrude's construction period could have been shortened by up to one and one-half years if there had been an ample supply of pipefitters and electricians. In her analysis of the risks facing future development of new energy sources, Judith Maxwell cites massive construction labour demands in remote areas as a reason why tar sands plants will have to be built on a staggered basis.[4] Recent developments in the Alberta construction industry have "overlaid" planned construction of a third tar sands plant, a heavy oil extraction plant and a major natural gas pipeline over a construction sector already bustling with a heavy "normal" complement of gas plants, power generation stations, petrochemical complexes and expansion of other existing facilities.

Industry concerns. It was against this background

that the subject of labour supply came up during a discussion of possible thesis topics with Mr. W. N. Sande, then Executive Vice-President of Syncrude Canada Ltd. in the summer of 1977. Mr. Sande was concerned that construction of the Shell tar sands plant and the Imperial Oil heavy oil plant at the same time would seriously unbalance an already tight labour market and would hamper Syncrude plans for additional construction in the near future. Mr. Sande was also concerned about the lack of published information on this particular aspect of the labour market. The subject for this thesis was chosen as a result of this meeting with the dual objective of contributing to the store of knowledge in my own industry as well as meeting my academic course requirements. The purpose of this study is to improve current understanding of the functioning of the Alberta construction labour market by investigating the ability of the market to react to demands for skilled construction tradesmen generated by simultaneous execution of several large scale projects.

Conceptual Framework

The general concept of a market is of a place of exchange where demand and supply forces interact to reach an equilibrium of interests. The market principle is used in various contexts ranging from a specific physical area where buyers and sellers meet face to face in the transaction of their business to the abstract workings of modern international trade. The application of the market idea to labour

demand-supply pressures is an abstraction. The term "labour market" is collective and refers to many separate trading areas; local, worldwide, occupational and industry.[5] The main function of each of these labour markets is "to fix wages and other terms of employment and to allocate labour among occupations, jobs and employers."[6] The labour allocation aspect of the Alberta construction labour market is the main topic of this thesis.

The neo-classical theory. The most widely held theory of the labour market is the neo-classical theory. This theory is described by Sar A. Levitan et al. as assuming a perfectly competitive labour market with the following attributes:[7]

Supply Side -

(1) Workers have perfect knowledge of the market, including information on wage rates and available opportunities.

(2) Workers are rational and respond to differences in rates of return, including wages and non cash benefits.

(3) Workers are perfectly mobile.

(4) Workers are not organized and make their own decisions on accepting jobs and wages offered.

Demand Side -

(1) Full and perfect knowledge of the labour market by employers.

(2) Employers are rational and attempt to maximize profits.

(3) No employer represents a large enough part of the total demand for labour to effect wages.

(4) Employers act individually, and not in concert, in fixing wages.

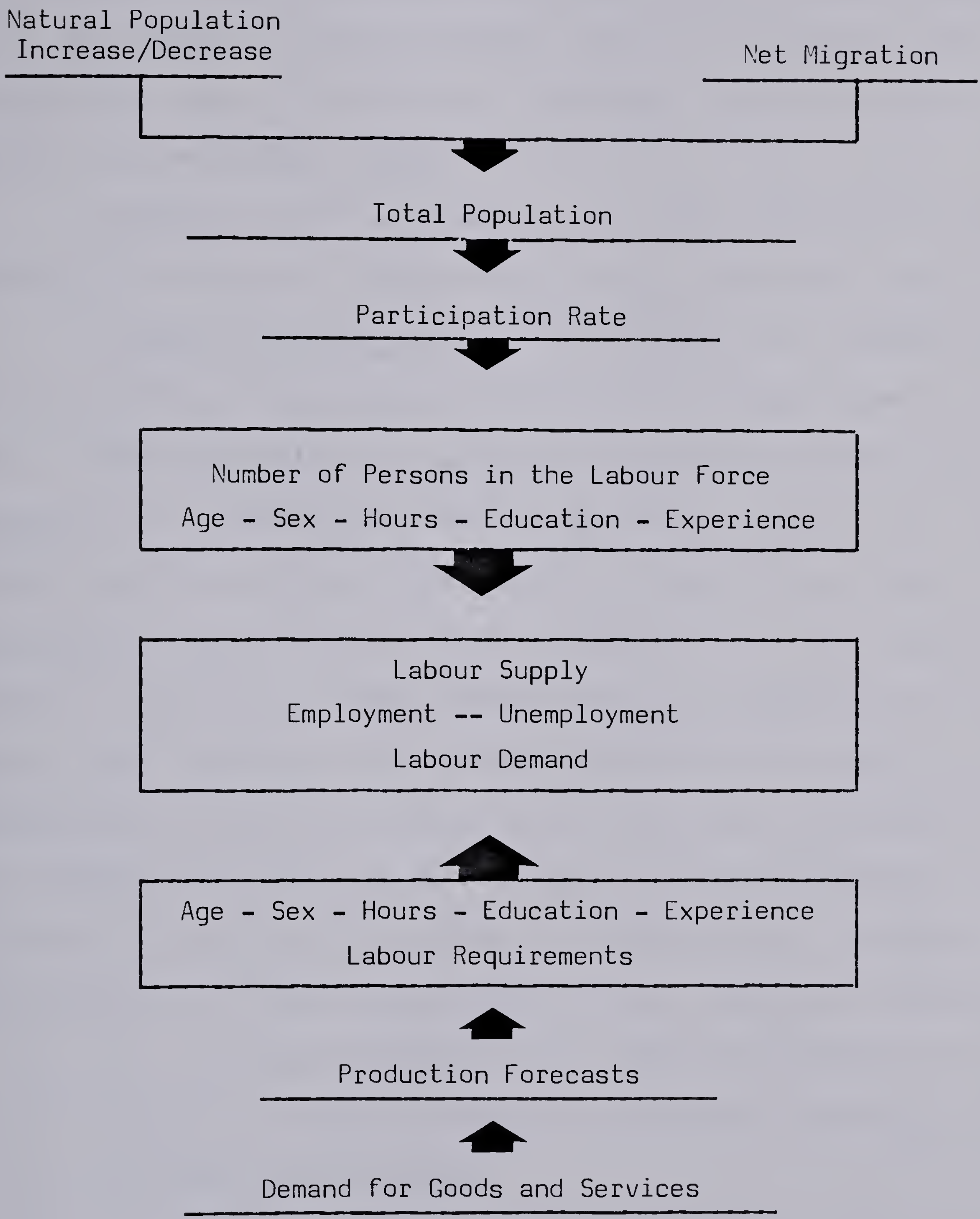
The basis of the theory is that wages and employment are determined by demand and supply. Demand is determined

by the marginal productivity of homogeneous units of labour. Marginal productivity is defined as the additional contribution to total revenue from the sale of the product of an added unit of labour. The optimum demand for labour is reached when, under conditions of perfect competition, the cost of the last unit of labour equals the extra revenue from sale of the last unit of production. In any study labour demand, based on the marginal productivity theory, is relatively easier to determine than aggregate supply. Supply of labour is influenced by many variables including education, market information, mobility and craft mix. A further complicating factor is the worker's utility function, the trade-off as determined by each individual worker, of potential consumption (higher earnings) versus potential leisure (lower earnings).

Neo-classical theory has been interpreted by various writers into general models that illustrate the relationship of the factors influencing operation of the labour market.[8] Figure 1-1 summarizes the stocks and flows which interact to form the labour market. As mentioned above, each stock and flow is multi-dimensional with supply and demand sides diversified into many individual characteristics. The chart illustrates the function of the labour market, allocation of labour resources to specific areas of demand, the aggregate matching of many job requirements with the qualifications of individual workers. The supply side has two major components, quantity and quality. Quantity of labour supply is determ-

Figure 1-1

The Labour Market - Interaction of Demand and Supply



Derived from: Human Resources and Labour Markets, Sar A. Levitan, Garth L. Mangum and Kay Marshall.

ined by the size of the total population, which in turn depends on rate of natural increase (or decrease), net migration, age-sex composition of the population, participation rate and number of hours worked. Quality refers to the amount and type of education, training, experience and health of the labour force.

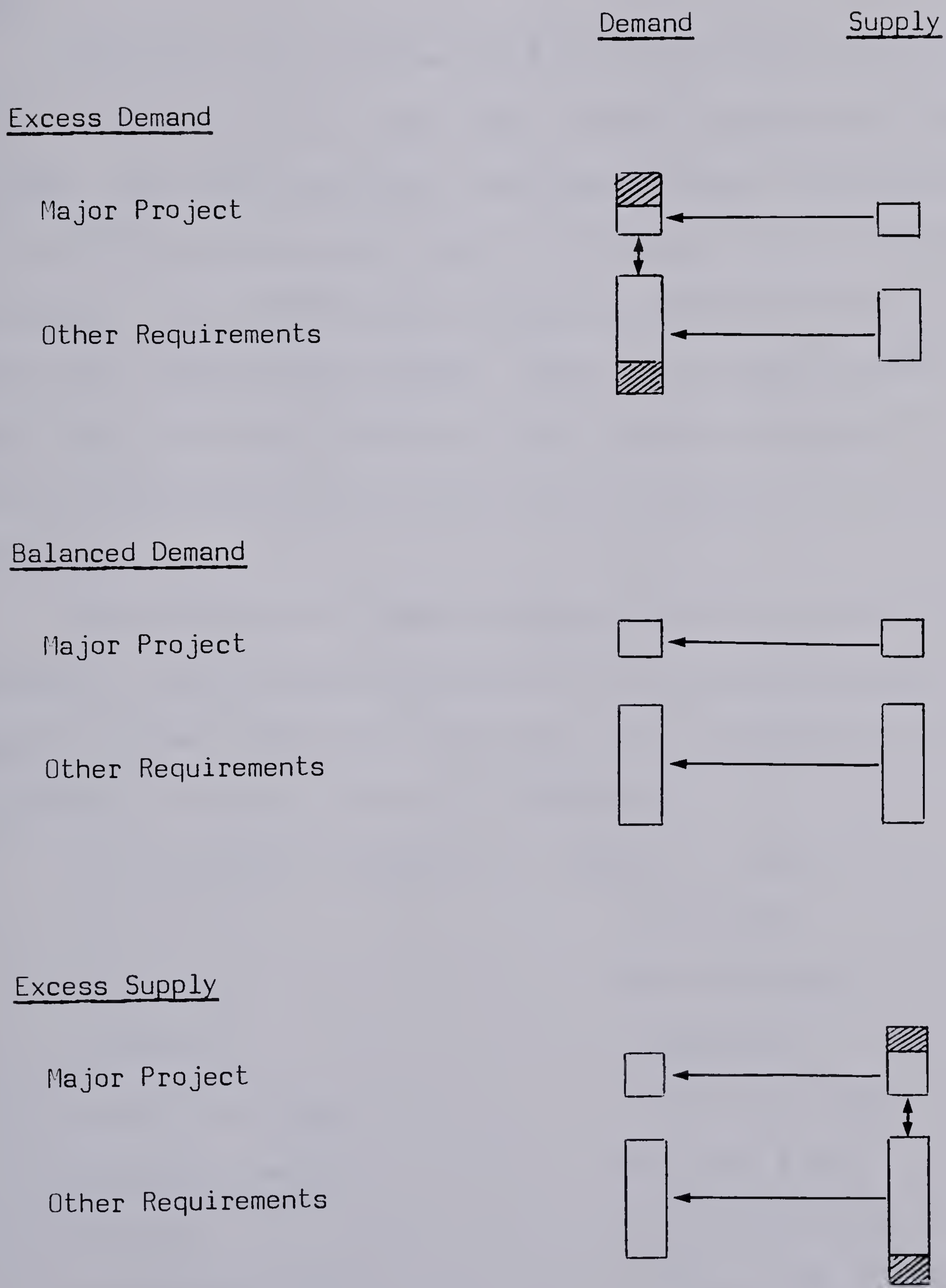
Demand side requirements for goods and services depend on the state of the economy and on government policy.

Area of concentration. This study will concentrate on the construction labour sector of the Alberta labour market. Basis is that this sector of the labour market can be thought of in simplified form as shown in Figure 1-2. The market is always in an unbalanced or competitive state. In periods of excess demand there is competition for workers while in periods of slack demand there is competition for jobs. The objective of manpower planning for a major construction project, therefore, is to estimate the imbalance and imperfections in the market and to take necessary corrective action so that the project can proceed on schedule. This thesis will develop answers to the following concerns:

1. To what extent did the manpower planning for the Syncrude project recognize potential imperfections in the labour market?
2. What steps were taken to minimize effect of market imperfections?
3. How did the labour market actually react to demand pressure from Syncrude?

Figure 1-2

Construction Labour Market
Competitive Model



Derived from Figure 1-1.

4. Was planned manpower strategy successful?

5. How can the Syncrude experience be utilized in manpower planning for the mega projects proposed for the period under study?

Scope

Research is confined to the construction labour market in Alberta and covers the 15-year period from 1974 to 1988. The first portion investigates the Syncrude period 1974 to 1978 covering the pre-construction planning features of manpower recruitment and the actual manning experience during the construction phase. The years 1980 to 1988 considers the potential effects on the construction labour market of large scale new projects in the light of Syncrude experience.

Development of labour demand estimates required analysis of mega projects planned for the period under study. Projects chosen were ones for which plans appeared to be firm, speculative projects were not considered.

The projects analyzed in Chapter IV are:

*G.C.O.S.	-	Expansion
Syncrude	-	Debottleneck
Syncrude	-	Expansion
Esso Resources	-	Heavy Oil Plant
Alberta Energy	-	Benzene Plant
Alsands	-	Tar Sands Plant
Foothills	-	Natural Gas Pipeline
Polar	-	Natural Gas Pipeline

Alberta Energy	-	Synthetic Gas Plant
Irving Steel	-	Steel Foundry
Forestburg Collieries	-	Coal Treatment Plant
Union Oil	-	Coal Treatment

* Name changed to Suncor Inc. August 22, 1979.

Methodology

Concept of the analysis is to consider the Alberta construction labour market in three stages:

1. Syncrude experience
2. Forecast demand by new projects
3. Anticipated market reaction to new demands.

Research into the Syncrude experience covers elements of the pre-construction planning process:

1. Forecast of manpower requirements
2. Potential sources of supply
3. Steps taken to ensure an adequate supply of necessary skills,

and comparison of actual performance with projections:

1. Actual requirements
2. Actual sources of supply
3. Results of direct actions in the market place.

Research involves interpretation of process reports and other documentation issued by Syncrude and the Managing Contractor and personal interviews with members of the management team involved with the labour recruitment process.

Forecasts of the construction labour demand generated by planned projects have been prepared in detail by the author

for each project and are presented in Chapter IV. Manpower requirements are calculated by conversion of published investment costs to equivalent craft manpower requirements by use of industry investment cost per man factors. The calculation steps used in the demand forecast process, with explanatory comments, are listed below:

1. Determination of expenditure profile. Media reports giving the duration of project construction phases have been used in conjunction with industry expenditure experience to calculate an expenditure profile for each project.

2. Constant dollar expenditures. Project investment costs are usually quoted in terms of total current expenditures required to complete the facility. To ensure consistent manpower projection derivations all expenditure profiles, including Syncrude, have been converted to constant 1977 dollars.

3. Manpower to expenditure ratio. The average number of man-years per thousand dollars of construction expenditure was determined for each project from industry standards or actual Syncrude statistics as applicable.

4. Average annual workforce. This requirement has been calculated from the relationship of the number of workers per thousand dollars of construction expenditure to the annualized total expenditure profile.

5. Average work week. The work force levels have been initially calculated on the basis of a 48 hour work week. Requirements for the 40 hour week case have been

extrapolated from this data.

6. Craft requirements. Individual craft requirements have been calculated for each project by application of industry or Syncrude craft mix factors, as applicable, to annual workforce projections.

Syncrude experience is used in formulation of assumptions as to how the supply side of the market will react, particularly as to sources of incremental workers.

Literature Survey

As pointed out by John L. Iacobelli,

> While there are various models and techniques to forecast labour demand or supply, most of these deal with forecasting for the economy. There have been some attempts to forecast local labour demand, but they have seldom considered the supply side or how to match labour supply into both macro and micro labour demand.[9]

Content of current literature generally follows national concerns as expressed in government policy. Canadian interest in manpower planning and programs was stimulated in the early sixties by policies which formulated five general goals for the Canadian economy: (1) a relatively high and stable rate of growth; (2) a viable balance of payments; (3) an equitable distribution of rising incomes; (4) a high level of employment, defined as a situation with a maximum of three per cent unemployment; and (5) reasonable price stability, defined as a maximum increase of two per cent per year in the Gross National Expenditure price deflator.[10] These goals were translated by the Department of Manpower and Immigration into three major objectives:

1. Long-run economic growth.

2. Reduction of poverty and inter-regional disparities in income.

3. Stabilization of the rate of price increase while maintaining full employment.[11]

In practice, emphasis appears to have been placed on items 1 and 3 with reduction of poverty being left to other agencies. It is not surprising, therefore, to find that a major portion of current Canadian material is devoted to the effect of active manpower programs on the economy, effectiveness of the Canadian labour market in satisfying demand-supply imbalances, demands for retraining, frictional unemployment and labour mobility. Literature has not yet recognized that poor performance of the Canadian economy in recent years has shifted emphasis from institutional training to on-the-job training and from job matching to job creation. In other words, programs designed to increase and improve the labour force must be demand driven to ensure their integrity. American literature reflects the "social" concerns of U.S. manpower policy as compared to the "economy" objectives of Canadian policy. The United States does not have full employment as a policy objective but is concerned with bringing disadvantaged minorities (Chicanos, Indians, blacks and the poor) into the workforce and with elimination of discrimination.[12] As this study is essentially concerned with forecasting labour demand-supply effects of large construction projects in a provincial labour market, the literature was reviewed in search of applicable references.

<u>The St. Lawrence Seaway project</u>. Description of management of the large demand for construction workers generated by the St. Lawrence Seaway Project by Donald E. Cullen contains several points that should be considered by Alberta planners.[13] The seaway project opened up a large labour demand in a relatively remote and sparsely populated area. Individual sections of the project were built independently by U.S. and Canadian workers. Recruiting for the U.S. labour force was done on an informal basis. The national labour market was such that workers flocked into the area as soon as the project was announced. State authorities had to discourage workers from coming to the job site ahead of time. The Canadian labour force was recruited on a more structured basis. All Canadian workers were recruited through the National Employment Service. Lists of job vacancies were sent to local officers for publication. Applications were screened and initial interviews were held by local officers. Suitable candidates were sent to the job site for final interviews and hiring documentation.

Wage scales were moderate and in line with other areas. Monetary incentive was offered by 44 and 48 hour work weeks. This experience raises doubts as to the incentive effectiveness of the current 40 hour work week in Alberta. This point is raised again in Chapter V.

The Canadian system is more practical as it reduces the social problems caused by masses of workers descending on rural areas not equipped to handle large transient popu-

lations. Screening by local employment offices also helps to ensure that workers with special skills are available when required. Creation of a central employment clearing house can provide up-to-date information on manpower requirements if used as a liaison between project management and recruiters. A central agency can also act as a communication or allocation function if two or more projects are competing for workers.

Kaliski's theory. In a recent article, S. F. Kaliski addressed the question as to "whether or not there is in Canada a danger that occupational structural unemployment would prevent the attainment of satisfactory levels of aggregate employment, at least without an unacceptable degree of inflation."[14] The topic is of interest to this thesis as Kaliski's investigation, "amounts to asking whether shortages of workers possessing particular skills are likely to halt a cyclical expansion before other (less skilled) workers are fully employed." This question is similar to the subject of this study. Will shortages of skilled construction workers curtail planned projects? Kaliski's work is based on the Berman theory of structural unemployment in the short run. It states that there are given supplies of skilled and unskilled labour or of each of the several skill classes of labour. These supplies are dependent upon production and change with changes in the level of output. The ratio of unskilled to skilled labour increases as the output does.

The capacity of the economy is such that some class

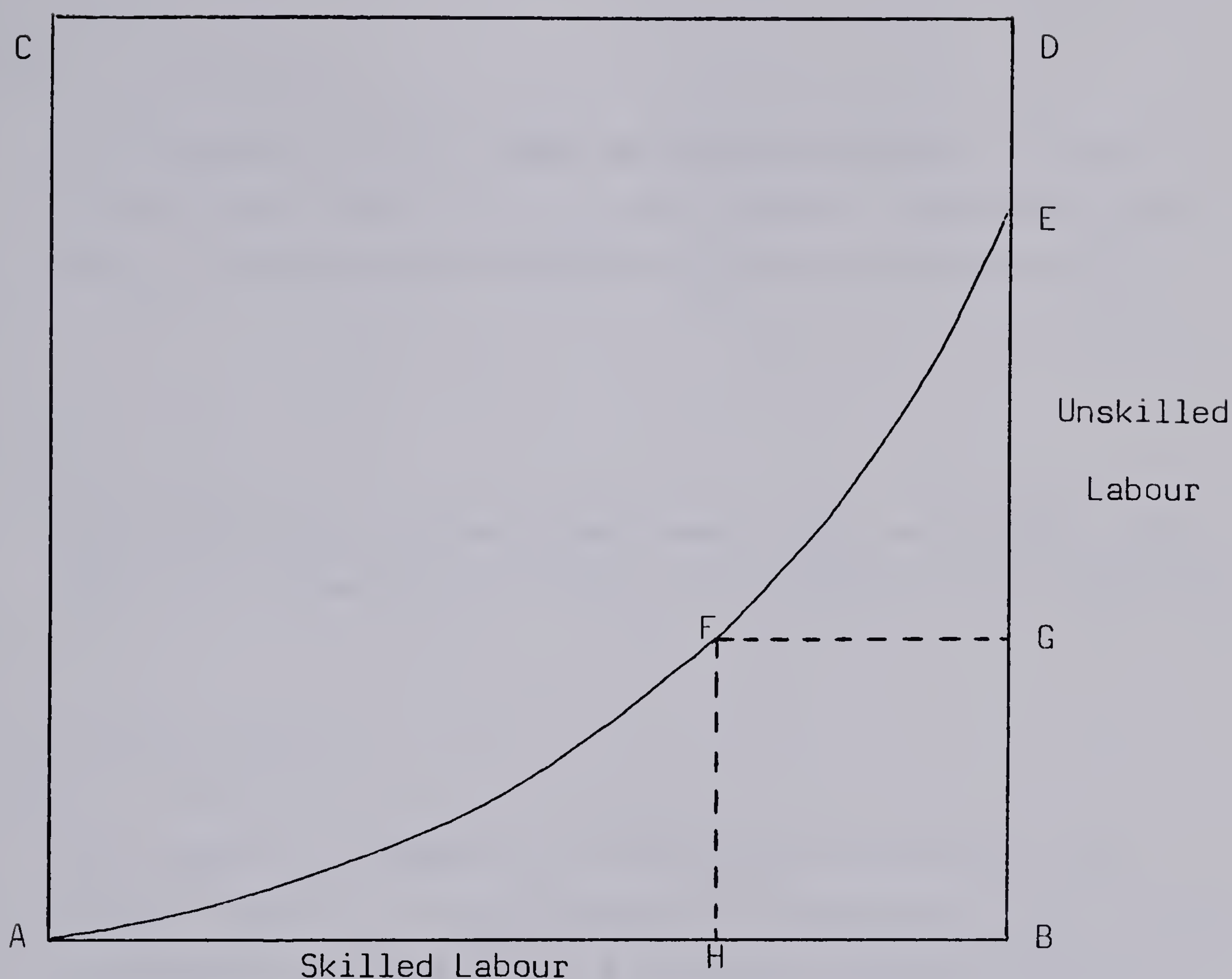
of skilled labour is the operative constraint on the production of goods and services. If demand is insufficient to reach this constraint, there is aggregative unemployment. If, at the output level at which the constraint is reached, there is a coincidence between the ratios in which the various classes of labour are available and the ratios in which they are required in production, there is no unemployment. If, however, the ratios do not coincide some groups suffer structural unemployment. This situation can only be improved by a combination of changed ratios and increased demand. Kaliski modified Berman's theory by derivation of a set of simultaneous equations which were applied to official DBS statistics for the years 1948 - 1965, as illustrated in Figures 1-3 and 1-4.

Results achieved were unsatisfactory for a variety of reasons, however, Kaliski states that the estimates obtained "suggest that expansions of the magnitude observed in the postwar period can take place without requiring additional highly skilled workers."[15] This conclusion is immediately qualified by references to the quality of the estimates and the high level of occupational aggregation. It would seem that a program of this nature could be used as a directional indicator for regional or sector applications.

Meltz analysis of labour markets. In a recent paper Noah Meltz has developed a framework for examining the operation of individual labour markets from the point of view of possible government action to correct imbalances.[16] Meltz'

Figure 1-3

Edgeworth Box Illustration of Berman
Theory of Structural Unemployment



Production cannot proceed beyond the output corresponding to the point E on the curve because of the limitation of skilled labour supply. If E does not coincident with D, DE of the unskilled labour force are unemployed. If due to low demand production level is F, then FG = HB of the skilled labour force and DG of the unskilled labour force will be unemployed.

Source: S. F. Kaliski, "Structural Unemployment in Canada: The Occupational Dimension," The Canadian Journal of Economics, Vol.2, No.2, May 1969.

Figure 1-4

Berman Theory of Structural Unemployment
Kaliski's Equations

(1) $E_{it} = fi\ (O_t, G_t, t)$.

Relationship of the number of persons employed in the i th occupational group (E_{it}) to the volume of aggregate output (O_t), some cyclical indicator (G_t) and a time trend (t).

(2) $O_t \leqslant g_i\ (E_{it})$.

Representation of the Berman theory that, at certain times, general or specific shortages of labour may limit production.

(3) $L_{it} = Fi\ (E_{it}, G_t, t)$.

The number of persons in a particular occupation in the labour force (L_{it}) was assumed to be dependant on the number of persons employed (E_{it}), a cyclical indicator (G_t) and a time trend (t).

(4) $E_{it} \leqslant L_{it}$.

Representation of the relationship of employment (E_{it}) to the labour force (L_{it}). Employment can fall short of the labour force but cannot exceed it.

Source: S. F. Kaliski, "Structural Unemployment in Canada: The Occupational Dimension," The Canadian Journal of Economics, Vol.2, No.2, May 1969.

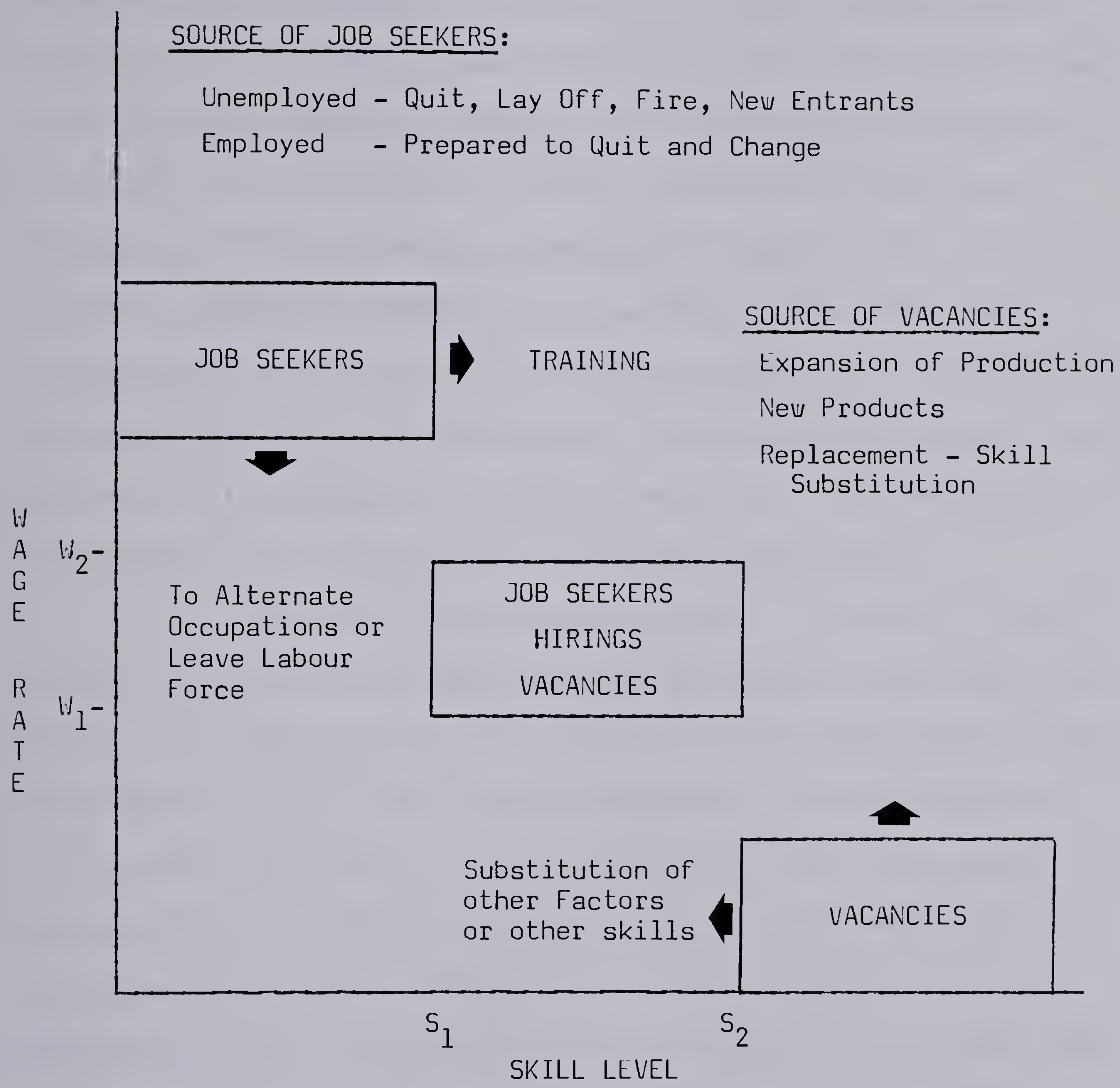
model, outlined in Figure 1-5 describes the adjustment process in individual labour markets recognizing the realities of imperfect information, lack of instantaneous adjustments and the dynamic nature of the labour market. Concept is applied to a specific labour market in two stages; (1) collection of data on vacancies and unplaced job seekers in the occupations to be studied, (2) analysis of data in terms of average length of time to fill vacancies, wage rates, location and special requirements. Data on skill requirements and elasticity of occupational substitution are also required to complete the analysis.

The article gives a practical example of application of this procedure by analyzing three diverse labour markets. Results obtained gave a detailed insight into the operation of each market and identified potential areas where outside (government) intervention could improve the demand-supply balance. Meltz' procedure is in effect an in-depth analysis of a local labour market, using existing manpower statistics. The principle can be easily applied in any situation but would seem to require centralized direction to achieve maximum results. Meltz does not indicate how his technique should be used as a regular manpower planning tool. Possible method would be to have teams of researchers and analysts attached to Canada Manpower Centres who could analyze chronic or critical situations and recommend corrective action.

<u>Adequacy of market knowledge</u>. One of the concerns in filling jobs in isolated regions is the question of informa-

Figure 1-5

Dynamic Operation of the Labour Market



$W_1 - W_2$: Predominant Range of Hiring Rates

$S_1 - S_2$: Predominant Range of Hiring Skills

Source: Noah M. Meltz, "Identifying Source of Imbalance in Individual Labour Markets," Relations Industrielles, Vol.3, No.2, 1976.

tion, will job seekers know about job vacancies in distant parts of the country? Industry opinion appears to feel that media exposure is adequate to generate a flow of workers possessing the necessary skills.[17] A study on the search aspects of frictional unemployment carried out by Bruce and Marshall addressed this question.[18] Object of the paper was to obtain some empirical evidence concerning job-search behaviour of frictionally unemployed workers. The article gives four general causes contributing to the time spent frictionally unemployed: (1) random choosing of prospective employers; (2) workers are poorly informed as to market conditions; (3) workers set aside a period of time to gather information; (4) waiting for preferred vacancies.

The interview technique was used to survey a small, geographically concentrated market of female clerk-typists. Results did not support the causes of frictional employment noted above as (1) most interviewees felt they had sufficient market information; (2) workers did not consciously seek additional information; (3) applications were made to firms about which prior information was known, firms with poor reputations were avoided; (4) 96 per cent of the sample had established a minimum acceptance wage, only 12 per cent actually used it as a basis for rejecting a job offer. Results tend to support the industry view that workers have sufficient knowledge of the market to seek out vacancies and do a good job of screening prospective employers. Due to the size and nature of the sample, these results cannot be

accepted as conclusive. As the authors point out, heads of families and skilled workers would likely take different approaches. Family heads would allow less time to lapse before beginning the job search and skilled workers may spend more time gathering information.

Manpower forecasting. As noted above, this project is essentially an exercise in forecasting, however, as a researcher in this field has stated, "there is no universally accepted or settled methodology for manpower forecasting."[19] In his study, Mehmet has dealt with seven methods of forecasting manpower requirements by industries and occupations:

1. The econometric method
2. The productivity method
3. The trend projection method
4. The employers' survey method
5. The method of forecasting specialized manpower requirements
6. The inter-area comparisons method
7. The elasticity of factor substitution method.

Brief descriptions and comments on each of the methods are listed below.

The econometric method - This technique can be used for deriving labour requirements from estimated demand for goods and services in some future year. Based on the input-output table principle showing interindustry flows and levels of final demand with an exogeneously determined labour supply. Input-output tables are recast into a sector matrix

and aggregate manpower requirements are derived to achieve forecast production levels. To develop the equivalent manpower required it is necessary to know the output per man-year to convert dollars to man years. One limitation to this model is the required detail and accuracy of base data is not always available.

The productivity method - Determines level of target year employment based on changes in labour productivity and growth of output. Target year output is converted to equivalent manpower on the basis of productivity per man. Supply is projected from base year employment in the sector or occupation under study. Weaknesses in applications have centered on determination of target-year output, derivation of occupational requirements and relationships between specific educational qualifications and specific occupations.

The trend projection method - Used to project past trends of labour requirements to the target year. Procedure can be either manual or programmed (regression method), requires several years of historical time-series. This method has a major weakness in that results are biased by the shape of past trends.

The employers' survey method - Employers' requirements for the classification of manpower being forecast are obtained by questionnaire and used to calculate the estimate. This is a simple method of obtaining information about future market conditions but has some drawbacks particularly carelessness or misinterpretation in the answering of question-

naires.

Specialized manpower requirements - In this category Mehmet groups all professions which normally require university training. Various techniques are discussed including; basis of need, workload, aggregate economic value, ratio method and employers' survey.

Inter-area comparisons - This method involves comparison of a base country or region with another of a (generally) more advanced economy. Use of this method is twofold: (1) assessment of current manpower situation with comparable economies; (2) comparisons with more advanced economies as a general forecasting tool (a crude approach to projecting state of the manpower sector at higher levels of economic development).

Elasticity of factor substitution - This is a theoretical concept included for the sake of completeness. The theory concerns the historical change in relative factor prices due to technical innovation. It is proposed that application of past trends to future market factor proportions can be used to derive future manpower requirements.

The current literature contains many examples of field investigations of the labour market including manpower forecasting. Several typical cases are described in the following pages.

MacKay et al. conducted a survey of various aspects of employers' reactions to labour market problems in British engineering industry in four different geographical areas

by analysis of employers' records, a variation of the survey method.[20] This method of analysis identified the labour market policies of employees, in the four areas surveyed, on such matters as wage policies, in-plant upgrading and downgrading, redundancy procedures, hiring standards, recruitment and forecasting. Of interest is that all firms studied based their forecasts of manpower requirements on their short-term confirmed order bookings. Only eight out of 66 firms forecast more than one year ahead. Forecasts in general were "rudementary" and none too accurate. Slack employment in the industry is suggested as a possible reason for the lack of interest in well-developed forecasting procedures.[21]

Another application of the survey method is described by Franke and Sobel.[22] Employer and worker interviews were used to gather data for a study of the relationship between occupational shortages and the operational effectiveness of the labour market process. Six skilled and technical occupations were studied in two large labour markets. The success of the study was due to use of a well-designed questionnaire which appeared to be well received by both employers and employees and the co-operation of persons and institutions being interviewed.

A Canadian application of the survey method of manpower forecasting was analyzed by Douglas G. Hartle several years ago.[23] Hartle comments on the Employment Forecast Survey (EFS) introduced by the Department of Labour in 1946

as part of the economic stabilization program. Concept of the EFS is to poll a constant sample of approximately 800 firms every quarter asking level of actual employment for each of the preceding three months and forecasts of employment three and six months in the future. Reports are aggregated by industrial classifications and used to project the DBS employment index. Hartle states that results have not been too satisfactory due principally to unreliable industry forecasts. Problems are in the areas of lack of seasonally adjusted data, imprecise recognition of industry economic cycles and general apathy. Hartle sums up by stating, "the forecast surveys were originally undertaken in the hope that reliable industry predictions could be obtained. . . . This investigation. . . has found them to be inadequate."[24] The implication appears to be that data collected on a routine, impersonal basis, from respondents who can see no direct benefit from the report, may be inaccurate and should be treated as rough approximations rather than as careful predictions. A point not developed by Hartle is the failure of field representatives to interview each establishment every quarter. Doubtless lack of personal contact is a main contributor to weak and inconsistent data.

A more recent approach to manpower forecasting in Canada has been undertaken by Watson and Butorac.[25] This study is an attempt to forecast educational needs in Ontario by means of a demand approach, the definition of teaching staff and capital required to train the supply of profes-

sional, technical and skilled workers indicated by population and economic trend projections. Demands for various categories of workers are derived from overall projections of population and economic growth for Canada and Ontario, by use of the compound interest method of calculation modified as required for special circumstances. The report gives ample documentation of changes in conditions and assumptions from the base census years of 1941 - 51 - 61 that have been used in the growth rate assumptions for each occupation studied.

As noted above, Iacobelli and Muczyk have developed an industrial-occupational forecasting program for use at a regional level.[26] Forecasts generated by this model reflect local industry mix, development patterns and associated shifts in occupational employment. The effects of technological change on manpower requirements can also be recognized through changes in the composition of labour inputs required for a given unit of production. Forecasts are developed for specific industries by means of a multiple regression formula which extents 96 months into the future. Occupational levels are calculated by reference to Bureau of Labour Statistics. This program is a practical approach to regional forecasting as the authors claim, but the use of national statistics to determine occupational levels negates any local flavour and contradicts the introduction to the article. The labour market conditions predicted for Alberta in the near term appear to be too volatile for meaningful application of this

method.

The Canadian version of a demand forecasting model is the Canadian Occupational Forecasting Program (COFOR). This program is designed to forecast, on a national basis, and by province, future manpower requirements within several hundred occupational categories. Work is carried out by the Department of Manpower and Immigration with regional input from provincial government agencies. Results are a seven year demand forecast, nationally and by province, in terms of replacements and net change due to economic factors. While the principle upon which COFOR is based is sound, current implementation of the program has, in my view, two weaknesses. Firstly, labour demand is based on economic growth as defined by the Economic Council of Canada in the Ninth Annual Review; The Years to 1980, published in 1972. Secondly, COFOR results were not issued until several years later. Use of a production model that does not represent actual conditions and a publication lag of several years severely curtails usefulness of data generated. This fact is recognized in the COFOR publication by the qualifying statement, "forecasts are based on the best indications available on the economy, unforeseen events or improvements in forecasting techniques could significantly alter the results."[27] Use of Economic Council projections for economic growth issued in 1972 as the basis for manpower demand forecasts in Alberta does not recognize potential peak demands caused by current construction plans for major projects. Lack of this type of up-to-date

forecast data is a good example of the need for specialized, regional forecasts.

Much of the literature devoted to manpower planning is concerned with the theory and application of forecasting models. One article, however, states that all models are unrealistic as far as practical applications are concerned due to common conceptual deficiencies.[28] Klaus Weiermair asserts that the following issues must be settled in order to obtain meaningful results:

(1) Demand side questions concerning the substitution processes between capital and labour or between different types of labour.

(2) Supply side questions relating to the variables of occupational choice and labour mobility.

(3) Labour market questions dealing with imperfect assumptions on the effect of changes in education, technological shifts and changes in career patterns.

Weiermair's points are probably valid but he is ahead of his time. The article assumes a greater degree of sophistication in the state of the art than really exists or may be needed. He does not realize that manpower forecasting is indeed an art, in my view it is a tool that will provide directional indication of the future state of a labour market. Results require careful analysis and interpretation before judgmental actions are taken.

A more qualitative criticism of forecasting technique is offered by Proulx et al. in their study of the application of the COFOR model to selected labour markets.[29 30] Comments (as summarized from the French text) mainly deal with updates

and improvements to certain of the model's features:

1. Use of average productivity factors when examining manpower requirements for industries planning large-scale expansions.

2. Use of an implicit hypothesis that capacity is fully utilized.

3. Occupational distributions based on historical experience rather than current employment data.

4. Estimates not classified by sex.

5. No adjustments to reflect age-experience profiles by industry.

6. No adjustments for recent significant increases in turnover rates.

7. Insufficient adjustment for cyclical effects.

8. Inadequate disaggregation at provincial level.

Summary

One of today's major economic problems in Canada is obtaining a secure supply of crude oil at a realistic price. At present the most viable alternative open to Canada is expansion of indigenous petroleum reserves by development of tar sand and heavy oil deposits. Planning has advanced to the point where several of the required mega projects are ready to move into the construction stage. However, the industry is concerned that simultaneous construction of two or more extraction plants will create a shortage of skilled construction workers. This concern, combined with a lack of published information on the workings of the Alberta construction labour market, is the incentive for this study. The general concept of the study is the allocative function

of the labour market, the distribution of manpower resources among occupations, jobs and employees. In periods of excess demand there is competition for workers while in periods of slack demand there is competition for jobs.

The scope of the research is investigation of the reaction of the Alberta construction labour market to the large projects planned for the coming years through 1988. Methodology relies heavily on experience gained by the Syncrude project for calculation of demands and operation of the supply side of the labour market. Current literature surveyed generally covered national topics. However, reference has been made to several articles having a theoretical relationship to this thesis.

Chapter II describes the planning stage of the Syncrude project with emphasis on planning criteria, manpower demand forecast, craft development programs and recruiting strategy.

FOOTNOTES

[1] F. K. Spragins, former Chairman of the Board, Syncrude Canada Ltd., "The Canadian Challenge," presentation to the Canadian Institute of Mining and Metallurgy. Calgary, October 18, 1966.

[2] ______________, "The Role of the Athabasca Tar Sands in Making Canada Self-Sufficient in Oil," speech to the Calgary Chamber of Commerce - Calgary, December 7, 1973.

[3] Hu Harries & Associates Ltd., The Impact of the Syncrude Project on the Economy of Alberta, report prepared for the Alberta Department of Industry and Commerce. January, 1975, p.43.

[4] Judith Maxwell, Developing New Energy Sources: The Syncrude Case. C. D. Howe Research Institute No.10. November 1975, pp.19-20.

[5] Arthur Kruger develops this idea in his article, "Micro-Economic Theory Labour Allocation and Manpower Policy," Kruger, Arthur and Meltz, Noah M., editors, The Canadian Labour Market, University of Toronto, 1968, pp.47-48.

[6] Sar A. Levitan, Garth L. Mangum, Ray Marshall, Human Resources and Labour Markets, Harper & Row, New York, 1976, p.115.

[7] Ibid., pp.115-119.

[8] For recent models see Noah M. Meltz, "Manpower Policy: Nature, Objectives, Perspectives," Moore, Larry F., editor, Manpower Planning for Canadians, University of British Columbia, 1975, and Relations Industrielles, Vol.24, No.1, 1979. Les Presses de l'Universite Laval.

Keith Newton, "The Rationale for Government Involvement in Manpower Training in Canada: Theory and Evidence," Relations Industrielles, Vol.32, No.3, 1977. Les Presses de l'Universite Laval.

[9] John L. Iacobelli in the introduction to his article, "A Manpower Planning Model to Link and Penetrate Key Components of a Local Labour Market," Stern, James L., and Dennis, Barbara D., editors, Proceedings of the Twenty-Ninth Annual Winter Meeting, Industrial Relations Research Association, September 16-18, 1976, p.132.

[10] Quoted in Ninth Annual Review; The Years to 1980, Economic Council of Canada, Information Canada, Ottawa, 1972, p.89.

[11] See the article, "Current Objectives of Canadian Federal Manpower Programs," by Harish C. Jain and Robert J. Hines, Relations Industrielles, Vol.28, No.1, Universite Laval, 1973, for summary of history, objectives and current status of Canadian manpower programs.

[12] "Manpower Policies - Lessons for the U.S. from Foreign Experience," Somers, Gerald G., editor. Proceedings of the 1970 Annual Spring Meeting, Industrial Relations Research Association, May 8-9, 1970.

[13] Donald E. Cullen, "Labor-Market Aspects of the St. Lawrence Seaway Project," The Journal of Political Economy, University of Chicago Press, June 1960.

[14] S. F. Kaliski, "Structural Unemployment in Canada: The Occupational Dimension," in The Canadian Journal of Economics, Vol.2, No.2, May 1969. University of Toronto Press.

[15] Ibid.

[16] Noah M. Meltz, "Identifying Sources of Imbalance in Individual Labour Markets," Relations Industrielles, Vol.31, No.2, 1976. Les Presses de l'Universite Laval.

[17] R. B. Peterson, Vice-President of Heavy Oils for Esso Resources Canada Ltd., commenting on Energy Resources Conservation Board hearings on his company's application to build a heavy oil extraction plant at Cold Lake, Alberta, was not overly concerned about availability of construction labour. Edmonton Journal, January 5, 1979, p.H1.

[18] C. J. Bruce and J. H. Marshall, "Job Search and Frictional Unemployment," Relations Industrielles, Vol.31, No.3, 1976. Les Presses de l'Universite Laval.

[19] Ozay Mehmet, Methods of Forecasting Manpower Requirements, University of Toronto, 1965, p.1.

[20] D. J. MacKay, D. Boddy, J. Brach, J. A. Diach, N. Jones, Labour Markets Under Different Employment Conditions, George Allen & Unwin Ltd., London, 1971.

[21] Ibid., pp.328-335.

[22] Walter Franke and Irwin Sobel, The Shortage of Skilled and Technical Workers. D. C. Heath and Company, Lexington, Mass., 1970.

[23] Douglas G. Hartle, The Employment Forecast Survey, University of Toronto Press, Toronto, 1962.

[24] Ibid., pp.107-108.

[25] Cicely Watson and Joseph Butorac, Qualified Manpower in Ontario, 1961-1986, Volume 1: Determination and Projection of Basic Stocks, The Ontario Institute for Studies in Education, Toronto, 1968.

[26] John L. Iacobelli and Jan P. Muczyk, "An Industry-Occupational Forecast Incorporating Technological Change for Local/Regional Manpower Planning," The Academy of Management Review, Vol.1, No.2, April 1976.

[27] Canadian Occupational Forecasting Program, Forecasts of Occupational Demand to 1982, No.3, Alberta, p.3, Department of Manpower and Immigration.

[28] Klaus Weiermair, "A Note on Manpower Forecasting," Relations Industrielles, Vol.30, No.2, 1975. Les Presses de l'Universite Laval.

[29] Pierre-Paul Proulx, Luce Bourgault et Jean-Francois Manegre. "Candide-Cofoe et la prevision de Besoins en Main-d'oeuvie par Occupation et par Industrie Air Canada," Relations Industrielles, Vol.32, No.1, 1977. Les Presses de l'Universite Laval.

[30] COFOR (Canadian Occupational Forecasting Program) operated by the Department of Manpower and Immigration is described above.

Chapter II

SYNCRUDE EXPERIENCE: THE PLANNING STAGE

Introduction

The challenge of Syncrude from a technical standpoint is well known, the challenge of recruiting and maintaining a large workforce of sufficiently qualified craftsmen to carry out the project on schedule and on budget has not received the same publicity. The two billion dollar constructed value of the Syncrude facilities made it one of the largest projects under construction at that time in North America. The design was also innovative, it being the second commercial plant to be built, with a production capacity more than twice the size of the pioneer plant constructed in the same area ten years earlier. In addition to the sheer size and complexity of the project the construction site was in a sparsely populated area 300 miles north of Edmonton and 30 miles north of the town of Fort McMurray, the closest center of population. Other adverse factors were poor transportation links with major population and supply centers and severe weather conditions during a lengthy winter season.

This chapter will describe the manpower strategy planned by the Labour Relations department of Syncrude and the managing contractor to recruit a construction workforce

of the required size and skill mix to execute the project within time and cost schedules.[1]

Planning Criteria

Manpower planning was based on a set of general assumptions imposed by physical, political and organizational conditions. In the main these conditions were supportive of the recruiting effort, major factors being:

Location. The construction site was situated 300 miles north of the closest large center of population, near a town of 15,000 population having a fully employed work force. The remote location, coupled with a severe winter climate, dictated that the workforce could not be recruited locally and that substantial inducements would have to be offered to overcome the isolated area and the extremes of climate. It was assumed that tradesmen would generally be available from local Edmonton craft unions with individual skill shortages being recruited from national or international sources as required. All requisitioning of tradesmen would be placed initially with the Edmonton building trades locals.

Competitive climate. The high level of construction work in progress and planned for Alberta and Canada as a whole in the early 1970's indicated a continuing strong demand for craftsmen throughout the project construction period. Competing construction activity was expected to restrict the availability of skilled mechanical trades.

Source of workers. Due to the large ownership

interest held in the project by three levels of government it was necessary to maximize the intake of Canadian workers, firstly from Alberta and then from other parts of Canada. It was also a matter of concern that employment and training of Native people be encouraged. International recruitment would only be undertaken when all other avenues of Canadian supply had been exhausted.

Labour relations. Contractor and unions negotiated a "Site Agreement" for the duration of the project. This agreement specified a union shop and contained a "no strike - no lockout" clause, thereby creating a setting of labour-management stability free from annual pressures surrounding negotiations for contract renewal.

Wage rates. Wage structure was union scale at levels equal to or better than wage structure in other parts of Canada and the United States. A standard work week of 48 hours provided an automatic 20 per cent overtime as a minimum.

Camp facilities. First class camp accommodation was to be provided at work site for all tradesmen.

Decentralizational. In order to reduce construction site manpower requirements it was planned to carry out several operations in Edmonton. Facilities would be set up for a marshalling yard, fabrication shop and a pre-assembly area. Edmonton based operations also afforded employment opportunities for local tradesmen unable to travel to the Mildred Lake site. It was assumed for planning purposes that all Edmonton operations would be staffed with tradesmen drawn

exclusively from the local Edmonton labour pool.

Manpower Demand Forecast

The manpower demand forecast used throughout the life of the project for manpower planning purposes considered the Mildred Lake site only. As noted above, it was deemed that Edmonton based construction operations would be manned without difficulty from local sources. The project cost estimate was used as the source of manpower requirements for each craft. Material takeoffs were converted to equivalent men by application of contractor's standard labour manhours per unit of work modified by factors for productivity, site conditions and contractor's experience on similar projects.

Tabulations of the forecast monthly manpower requirements by craft for the Mildred Lake site for each of the years 1975 to 1978 are shown in Appendix A, Tables 1 to 4. Labour availability projections were developed from surveys of building trades locals across Canada, building trades councils, construction associations, international union representatives and statistics of licensed trades personnel and trainees published by the Government of Alberta. Information on supply of craftsmen and areas of labour surplus in the United States and overseas was also obtained from contacts within the project contractor's international organization. Seven of the 13 crafts identified were declared to be critical in that all tradesmen required could not be obtained from Edmonton locals. Appendix A, Tables 5 to 11 show the timing

and size of the expected local source shortfalls. Minor shortages were forecast for boilermakers, carpenters and pipefitter welders. Major supply deficiencies were projected for electricians, insulators, ironworkers and pipefitters. Possible sources of supply are identified in the tables as local, rest of Canada and outside Canada.

Survey results showed that Canadian construction activity, underway or planned, was generally brisk. In Alberta, there were 15 major industrial projects underway with a combined value of $750 million. Scheduled and expected new job starts would continue the high level of activity in 1977. Large construction programs in the Sarnia, Ontario and Saint John, New Brunswick areas were forecast to generate demands for labour in excess of local supplies. Tradesmen would be drawn from other parts of Canada, the United States and the United Kingdom, thus posing a competitive threat to Syncrude in obtaining manpower. The Olympic site in Montreal and the James Bay Power Project, along with several smaller projects in progress or planned created an active labour market in Quebec. There were expectations that some workers in the mechanical trades could be recruited for out-of-province work after completion of the Olympic facilities. Availability of tradesmen in Manitoba and Saskatchewan was found to be marginal, this situation was due to a small construction workforce rather than excessive local demand. Reduced construction activity in British Columbia indicated available supplies in all trades. Newfoundland was also expected to

be a good source of manpower, inspite of competition from the Maritimes. In summary, main areas in Canada capable of supplying trained tradesmen were expected to be British Columbia and Newfoundland with some support from Quebec in the latter years of the project. Ontario and the Maritimes were assumed to be in positions of short supply while Manitoba and Saskatchewan did not have a sufficient base population of construction workers.

Active Training Programs

Several programs were implemented in the training and recruiting areas by the contractor in order to supplement natural migration in filling project construction manpower requirements. Major activities are described below.

Apprenticeship programs. One source of increased manpower is training of new tradesmen and upgrading of craft skills. Apprenticeship training, pre-employment programs and vocational training all contribute to the pool of skilled craftsmen.

Apprenticeship programs were set up for boilermakers, insulators, ironworkers, carpenters and electricians. The ratio of apprentices to journeymen was approximately one to five at the job peak, with insulators being one to four. The apprenticeship program was instituted with full approval and co-operation of the government agencies involved, over some resistance by local contractors. The contractors had two main concerns; quality of tradesmen turned out may be

too specialized with all emphasis on the industrial side of the trade, further apprentices trained on a large job with many fringe benefits as inducements may expect the same treatment from all contractors. Consideration was given to minimizing the impact on other employers and to maintain a balance of apprentices in the yearly categories.

Pre-employment training. Pre-employment trained welders, turned out from Alberta colleges and technical institutes were another source of manpower. Contractor's labour relations representatives and welding training supervisors visited the training centres to evaluate and interview trainees for referral to the project or to training sites. Similar contact was made with vocational high schools to recruit pre-trained apprentices and with elementary and high schools to stimulate participation in the vocational program.

On-site training. In order to provide and maintain on a timely basis a sufficient quantity of suitably qualified welders a comprehensive on-site welding training program was developed. This need was dictated by the size of the project, heavy demand for welders on other projects, continuing escalating demand for welders with different levels of competency and requirements for compliance with welding specifications and standards. Training was carried out in welding schools located in Edmonton at the assembly yard and at the Mildred Lake site. Each school had 50 welding booths with a staff of a welding co-ordinator and three instructors.

Training included welding qualification tests, skill upgrading and instruction in specialized techniques. In addition to the welding program, on-site training activities were carried out for a variety of construction skills including: operating engineers - rigging and hoisting; carpenters - blueprint reading and layout; boilermakers - blueprint reading, splicing, rigging; electricians - code and theory; and pipefitters - instrumentation and blueprint reading.

Native Outreach program. Special training efforts were made through the Native Outreach program to recruit and train Native residents of the area. While many of the Native tradesmen worked as labourers, drivers or operating engineers, several successfully qualified as welders.

Recruiting

Recruiting of tradesmen was a continuous and ongoing process during the life of the project. A comprehensive recruiting procedure was developed to react to site demands and to ensure that a thorough and complete search was made of Canadian manpower sources. Main features of this procedure are described below:

1. Construction labour co-ordinator at the construction site advises labour relations department of manpower requirements.

2. Labour relations requests tradesmen from Edmonton Building Trades Locals.

3. If Edmonton Building Trades Locals cannot supply:

- Order is placed with the Canada Manpower Centre in Fort McMurray

- If there is no local area supply CMC releases information on Alberta Regional clearance list.

- Contractor's labour relations places newspaper advertisements in Alberta.

4. If orders are still not filled, additional actions are taken by labour relations:

- Requests Edmonton Building Trades Locals to contact their international representatives.

- Establishes direct contact with main supply locals in Western and Eastern Canada.

- Advises Western and Eastern International Building Trades representatives of requirements.

- Places newspaper advertisements in other provinces.

- Canada Manpower passes order to prairie region co-ordinator for further distribution.

5. If Canada Manpower and the Building Trades Unions are satisfied that tradesmen cannot be located in Canada or trained in time, further actions are necessary:

- Labour relations applies to Canada Manpower and Immigration for work permits to import foreign workers.

- United States Building Trades Locals are contacted where possible supplies of tradesmen are known to exist.

- If United States locals cannot supply Canada Manpower and Immigration are contacted for assistance in supplying qualified craftsmen from overseas, primarily from the United Kingdom.

Contractor's labour relations co-ordinators met quarterly with representatives of Canada Manpower and Immigration, Prairie Regional Manpower Office and the Alberta Manpower

Office to keep government agencies fully informed of project manpower requirements. Local Alberta contacts were maintained with the Department of Manpower and Advanced Education regarding training needs and with Edmonton Building Trades Locals regarding predicted manpower requirements and of changes to demand forecasts. Daily contact was maintained with the Canada Manpower Centre in Fort McMurray. Changes in conditions affecting manpower requirements and availability were monitored by the contractor and reported on a regular basis to Project Management. In this way internal control was exercised over forecasting and recruitment operations.

Summary

This chapter has reviewed the manpower planning aspects of the Syncrude project. Planning was based on a set of general assumptions that considered physical, political and organizational conditions. Manpower demand forecasting was concerned with the Mildred Lake site only, as it was assumed that the Edmonton based pre-assembly operations could be manned without difficulty from the local Edmonton market. Forecast technique followed the usual construction industry practice of applying standard labour manhours per unit of work to structural and equipment requirements. Demand so forecasted was equated to labour craft availability surveys to determine potential supply shortfalls. Results showed that seven out of 13 crafts surveyed could be critical as

supply could not be completely obtained from the local market area. As a result of the potential competitive labour market a series of training programs were established to up-grade skills and a recruiting network was established to obtain tradesmen from national and international sources.

The following chapter will discuss how the labour market reacted to meet the actual demands with emphasis on the recruiting plan, effect of changes in the Canadian economy and actual supply patterns.

FOOTNOTES

[1] Planning assumption information was generally obtained from the periodic, Manpower Recruiting Reports, issued by Canadian Bechtel Limited, supplemented by discussions with Syncrude and Bechtel project personnel.

Chapter III

SYNCRUDE EXPERIENCE: THE EXECUTION STAGE

Introduction

The preceding chapter outlined the recruiting strategy developed by the Syncrude project managing contractor in order to meet forecasted demands for skilled construction tradesmen. Strategy was planned in 1974 and 1975 at which time active and more importantly, planned heavy construction projects indicated that the construction labour market would be extremely competitive throughout the Syncrude construction period. This chapter will discuss how the recruiting plan worked in actual practice. Main topics will be how labour availability trends in the Canadian heavy construction industry were monitored, how changes in the Canadian economy affected the construction labour market, actual recruiting patterns and changes in the project labour demand forecast.

Monitoring the Labour Market

The managing contractor's manpower analysts continually monitored the labour demand-supply balance during the course of the project. Manpower requirements were updated every month based on progress to date and the estimated "to go" manhours required to complete the project. Requirements were projected by craft for each month of the project. The

supply side availability was developed through analysis of known and potential construction activities which competed for manpower with the Syncrude project in drawing tradesmen from local, provincial and national labour pools. Estimates of supply availabilities were constantly revised in reaction to announcements of project starts, postponements and cancellations. Advance predictions of potential recruitment problems facilitated forward planning of necessary corrective actions.

Manpower Recruiting Reports

Status of the labour supply situation was formally communicated to contractor and Syncrude project management teams by a series of Manpower Recruiting Reports.[1] Five such reports were issued during the course of the project. The first report issued in November 1975 outlined the recruiting strategy discussed in the previous chapter, contained the initial demand-supply balance estimates and projections of labour availability and sources. Critical sections were updated in February 1976, May 1976, January 1977, and May 1977. Reports followed a consistent format, although tabular presentations were improved in succeeding issues. Main subjects covered were:

Summary. This part contained; an overview of status to date, forecasts of demands and sources of manpower, overall assessment of national construction labour scene, potential shortages and planned actions, highlights of program for

employment of native people, including per cent native content of the work force, what trades were involved and status of trades apprenticeship.

Tables and charts showing current forecast of monthly manpower requirements by craft and projected source of supply; local, national or international.

Labour availability. Analysis of local and national heavy construction activity based on surveys made of building trades locals across Canada, building trades councils, contractors, contractors' associations, international union representatives, published government surveys and media reports. Assessment of the effect of changes in the heavy construction sector of the economy on availability of construction labour for the Syncrude project. Summary of recruitment sources for critical trades.

Progress reports on training programs were also included in this section. Featured were details of welder training and results of the Native Outreach program.

Recruiting. Status of recruiting progress, identification of specific problems and outline of action plans underway to maintain the work force.

Manpower forecast. A section of supporting tables showing the current forecast for Mildred Lake manpower by month by trade, forecast construction activity in Canada by province by year and value of each project and historical growth of licensed craftsmen in Alberta.

It should be remembered that the Manpower Recruiting

Report was only concerned with the construction labour force based at Mildred Lake. It was correctly assumed that the local Edmonton supply was sufficient to meet the needs of the Edmonton field office sites.

Changes in the Economy

The period 1975-1977 saw a significant change in the Canadian economy, particularly in the construction sector. Slowdowns and postponements of many major projects across Canada improved the outlook for Canadian recruitment of tradesmen for the Mildred Lake site. Labour market conditions were reflected by lowered estimates for international recruitment in successive Manpower Recruiting Reports, for example, the estimate of pipefitters and pipefitter welders required from the United States dropped from 750 to 100 as shown in Table 3-1.

Overall estimates of the proportion of tradesmen to be recruited internationally dropped from 15 per cent to 3 per cent as shown in Table 3-2.

How the effect of changed Canadian economic conditions on the project was reflected in successive Manpower Recruiting Reports will be discussed under two headings, economic trends and labour availability and market supply response.

Economic trends and labour availability. The first report issued in November 1975 indicated a buoyant construction sector with major projects scheduled or in progress in Ontario, Quebec and New Brunswick. Specific areas of activ-

Table 3-1

Syncrude Project Recruiting Plan

Number of Pipefitters and Pipefitter
Welders to be Recruited
in the United States

Report Date	International Recruits
November, 1975	750
February, 1976	750
May, 1976	550
January, 1977	200
May, 1977	100

Source: Canadian Bechtel Limited
Manpower Recruiting Reports.

Table 3-2

Syncrude Project Recruiting Plan

Projected Recruitment Sources
Mildred Lake Construction Labour

	Recruitment Source - Percent		
Report Date	Alberta	Canada (other than Alberta)	International
November, 1975	67	18	15
February, 1976	67	18	15
May, 1976	70	20	10
January, 1977	70	27	3
May, 1977	70	27	3

Source: Canadian Bechtel Limited
Manpower Recruiting Reports.

ity were; Sarnia in Ontario, Saint John, New Brunswick and the James Bay Power Project and the Olympic site in Quebec. The Syncrude managing contractor foresaw considerable competition for skilled mechanical tradesmen with a possibility of recruiting up to 15 per cent of the required labour force internationally.

The outlook contained in the February 1976 report was essentially unchanged. Mention was made of new projects planned for the Thunder Bay region in Ontario and Port Cartier, Quebec, which potentially tightened the competitive situation.

The May 1976 report indicated a significant softening in the Canadian construction labour market due to the cancellation, deferral, reduction in scope or extension of several large projects. Areas affected were New Brunswick and Thunder Bay, Ontario, where projects were cancelled or deferred. Deferrals by Ontario Hydro and extensions in other parts of Ontario also took pressure off the labour market. The projection for Syncrude labour availability consequently improved with a decrease in the estimate of international recruitment to 10 per cent.

By the January 1977 report, government cutbacks and uncertainty as to the effect of Anti-Inflation Board guidelines led to stretchouts and postponements of many projects and a general disincentive for capital investment. The construction sector, with the exception of Alberta, was described as "generally sluggish" and with "no growth." These

conditions were predicted to continue well into 1977, thus increasing the national supply of crafts not available in the local Edmonton market. Estimated level of international recruitment fell to 3 per cent of the Mildred Lake labour force. Discontinuance of the Manpower Recruiting Reports with the May 1977 issue, which in fact contained no new comments, indicated the managing contractor's confidence in the ability of the national construction labour market to satisfy all demands.

Market supply response. As construction activity slowed down in other parts of Canada, "transient" workmen moved to Alberta on a voluntary basis seeking employment. While a large number of the transients were unskilled and could not be placed on the Syncrude project, there were also many skilled craftsmen who found ready employment. The managing contractor and the unions worked together to develop a system to enable skilled transient tradesmen to qualify for Syncrude site work. Transients were accommodated by the Alberta union locals by issuance of a "job permit" which allowed the tradesman to work only on the Syncrude project. Job permits were of two types, "travelling permits" issued to qualified union members from outside Alberta and "work permits" issued to qualified non-union tradesmen. Layoff sequence due to project wind down was a pre-determined procedure agreed to by the managing contractor and the unions. Layoffs started with non-union workers progressed to non-Alberta union "travellers" and concluded with Alberta union-

ists.

The first recruiting report issued in November 1975 outlined general recruiting strategy, succeeding progress reports gave details of actual recruiting performance. In the third quarter of 1975 recruiting beyond the local union level was required to meet demands for electricians, heavy duty mechanics, ironworkers, pipefitters and plasterers. All except plasterers were available from national sources. The bulk of personnel required was obtained by inter-union transfer and responses to newspaper advertising. Referrals from Canada Manpower and hiring of new apprentices supplied the balance.

The shortage of plasterers was remedied by direct recruitment in the United States by the managing contractor, after work permit authorization by the Department of Manpower and Immigration. It took three weeks from initial request for work permits until workers arrived at the job site.

Shortages of boilermakers, ironworkers and welders in early 1976 necessitated recruitment action. Orders for boilermakers and ironworkers were filled by inter-union transfers. Welders and welders' trainees were recruited through newspaper advertising and Canada Manpower referrals.

Shortfalls developed in late 1976 for electricians, pipefitters, pipefitter welders, plasterers and ironworkers. Orders were mainly filled by newspaper advertisements supplemented by inter-union transfers and Canada Manpower referrals. A change in construction strategy in late 1977 created an

urgent requirement for insulators. Work permits were obtained from the Department of Manpower and Immigration to allow recruitment in the United Kingdom. Approximately 80 tradesmen were recruited and transported to the job site by chartered aircraft.

In many crafts over 50 per cent of referrals were non-Albertans. Inspite of this a continual source of concern was the high turnover rate among tradesmen obtained through local union sources as compared to tradesmen recruited outside the province. The lowest rate of turnover, as to be expected, was among workers who agreed to stay on the job a stipulated minimum number of months in return for payment of return passage to the point of recruitment.

Labour Market Supply Side Reactions

The recruitment actions described in the preceding section are the very few instances where shortages of tradesmen required recruiting search beyond the local union stage. The downturn in the Canadian construction industry created such a surplus of skilled tradesmen that most manpower requisitions were filled through the Edmonton building trades locals, either by area resident journeymen or by transient journeymen who had voluntarily migrated to Edmonton and had been issued "travelling permits." The few requisitions that could not be filled directly from the Edmonton locals were supplied by widening the communications network. Information about vacancies was passed to the marketplace through the

mediums of inter-union notices to hiring halls, Canada Manpower referrals and newspaper advertising. These methods of information release reached three different segments of the labour market; qualified union members from locals outside of the Edmonton area, new immigrants and non-union tradesmen. Only two crisis situations arose where journeymen had to be hired from international sources due to a short Canadian supply, the plasterer and insulator cases mentioned above.

Review of the Syncrude project indicates that the factors listed below combined to ensure an adequate labour force supply response at all times:

Site factors. Labour-management relations were stable due to negotiation of a site agreement specifying a union shop and containing a no strike - no lockout clause. Wage rates were union scale, equal to or better than competing areas. A standard work week of 48 hours provided a base overtime wage of 20 per cent.

Recruitment practices. The contractor's recruitment staff maintained close contact and a good working relationship with the Edmonton building trades locals, their business agents and international representatives. This procedure ensured that job vacancies were promptly followed up and that maximum use was made of the unions' internal information system.

Project size. While the huge scale of the Syncrude project required thousands of tradesmen, the large size was also an advantage in that it allowed a certain degree of

flexibility in work planning. If crews were held up in one area due to shortages in a specific trade they could generally be moved on to another part of the job, temporarily bypassing the bottleneck. There were no serious cases of work holdups due to shortages of qualified tradesmen with the exception of the insulation problem, referred to above, caused by changes in the job plan. Project size allowed for some pre-hiring of workers in anticipation of future work peaks and as insurance against unexpected market shortages.

Economic conditions. As described above, events in all other parts of the Canadian heavy construction sector caused unexpected work shortages. The resulting labour oversupply situation was to Syncrude's benefit in that surplus workers provided an abundant labour supply. The effect of this situation on sources of labour is illustrated in Tables 3-1 and 3-2 and in a large measure is the reason for lack of supply related problems during the course of the project.

Supply Source Patterns

During the course of the Syncrude project the general contractor maintained records of tradesmen's permanent residences at time of hire. Statistics were compiled by trade for each year and show the number of hirings classified as to province, United States or United Kingdom. Records do not indicate if a person was hired more than once in a given year or do they show the actual number of tradesmen employed. The statistics are valuable in that they give directional indica-

tion as to the sources of labour supply by craft during each year of the project.

The following tables summarize hiring source statistics. As shown in Table 3-3, 67.3 per cent of hires for the total project gave Alberta as their area of established residence, 32.0 per cent came from other parts of Canada and 0.7 per cent came from the United States and the United Kingdom. Table 3-4 derives the number of new hires deemed to be applicable to the Mildred Lake site. Table 3-5, for the Mildred Lake site only, shows that sources of hire were 63.8 per cent, 35.4 per cent and 0.8 per cent respectively averaged over the years 1975-1978 and 60.3 per cent, 38.7 per cent and 1.0 per cent averaged over the years 1976-1978, the period covered by the <u>Recruiting Reports</u>.

An Alberta labour force content of 60 per cent for the Mildred Lake site is considerably lower than the 70 per cent quoted in the <u>Recruiting Reports</u>. A possible explanation for the difference may be that it represents transient workers from other regions who voluntarily migrated to Alberta and were hired through Edmonton building trades locals rather than being directly recruited in their home districts. In any event, the available data indicates that a significant proportion of the project workers; in the order of 40 per cent at the Mildred Lake site or 32 per cent on a total project basis came originally from other parts of Canada, either by voluntary migration or by direct recruitment. Distribution of hires for the total project from provinces other

Table 3-3

Syncrude Project Recruiting Statistics

Mildred Lake and Edmonton Sites
Source of Tradesmen When Hired
for the First Time

Year		Total Hires	Area of Established Residence		
			Alberta	National	International
1975		6,830	5,426	1,386	18
	Per Cent	100.0	79.4	20.3	0.3
1976		10,251	6,498	3,445	8
	Per Cent	100.0	66.3	33.6	0.1
1977		12,124	7,141	4,870	113
	Per Cent	100.0	58.9	40.2	0.9
1978		5,691	4,111	1,465	115
	Per Cent	100.0	72.2	25.8	2.0
Total		34,896	23,476	11,166	254
	Per Cent	100.0	67.3	32.0	0.7

Source: Canadian Bechtel Limited
Recruiting Statistics.

Table 3-4

Calculation of New Hires Applicable to
Mildred Lake Site

	1975	1976	1977	1978
Total Manmonths Worked at Edmonton Sites	2,070	7,751	3,188	115
Average Staff Level	173	646	266	10
New Hires Required to Fill Jobs	519	1,983	798	30
Total Alberta New Hires	5,426	6,798	7,141	4,111
New Hires Applicable to Mildred Lake	4,907	4,815	6,343	4,081

Derivation: Manpower Recruiting Reports projected requirements for the Mildred Lake site only, recruiting statistics included both Mildred Lake and Edmonton sites. This calculation extracts Alberta new hires applicable to Mildred Lake through use of the following assumptions:

1. All manpower requirements for Edmonton sites were supplied from Alberta.
2. Average men per year as calculated fairly represents staff levels.
3. Turnover factor of three new hires to fill each job is realistic.

Table 3-5

Syncrude Project Recruiting Statistics

Mildred Lake Site Only

Source of Tradesmen When Hired for the First Time

Year		Total Hires	Area of Established Residence: Alberta	National	International
1975		6,311	4,907	1,386	18
	Per Cent	100.0	77.7	22.0	0.3
1976		8,268	4,815	3,445	8
	Per Cent	100.0	58.2	41.7	0.1
1977		11,326	6,343	4,870	113
	Per Cent	100.0	56.0	43.0	1.0
1978		5,661	4,081	1,465	115
	Per Cent	100.0	72.1	25.9	2.0
Total		31,566	20,146	11,166	254
	Per Cent	100.0	63.8	35.4	0.8

Source: Tables 3-3 and 3-4.

than Alberta is shown in Table 3-6. The overall proportion of national hires ranges from 20.3 per cent to 25.8 per cent. Numbers of hires from Ontario, Quebec and the Maritimes increased as the project peaked and co-incidentally as construction activity in other parts of Canada fell off. The above statistics give an indication of the labour market support from other provinces necessary to complete one Syncrude size project.

Labour Demand Forecasts

As stated earlier in this chapter, project manpower requirements were updated monthly based on progress to date and the estimated "to go" manhours required to complete the job. Requirements were projected by craft for each month of the project. Overall labour requirements varied from forecast to forecast as project scope was defined and execution strategy developed. Tables 3-7 and 3-8 showing forecasts from sequential Manpower Recruiting Reports illustrate how manpower forecasts changed in reaction to changes in physical construction plans. Additional statistics for the total project are contained in Appendix B.

Overall manmonths of construction labour required at the Mildred Lake site for the years 1976-1978 increased from an original forecast of 124,593 manmonths to an actual requirement of 143,685 manmonths, an increase in the order of 15 per cent. Deviations from the initial forecast to actual requirements are summarized for each year:

Table 3-6

Syncrude Project Recruiting Statistics

Mildred Lake and Edmonton Sites

Source of National Hires

(Canada - Other Than Alberta)

Per Cent of Total Hires	National Total	B.C. Yukon N.W.T.	Saskatchewan Manitoba	Ontario	Quebec	Maritimes
1975	20.3	9.9	3.2	3.7	1.6	1.9
1976	33.6	13.0	2.6	7.3	6.9	3.8
1977	40.2	8.3	2.2	9.7	10.4	9.6
1978	25.8	5.2	2.8	4.2	6.9	6.7
Project	32.0	9.5	2.6	6.9	7.1	5.9

Source: Canadian Bechtel Limited Recruiting Statistics.

Table 3-7

Syncrude Project

Construction Manpower Requirements

Mildred Lake Site - All Crafts

Demand in Manmonths	Report Dated: Nov/75 Feb/76	May/76	Jan/77	May/77	Actual
1976					
January	2,996	2,406	2,440	2,440	2,914
February	3,232	2,917	2,729	2,729	2,903
March	3,585	3,088	3,027	3,027	3,055
April	4,086	3,790	3,440	3,440	3,455
May	4,748	4,630	4,207	4,207	4,253
June	5,098	5,230	4,768	4,768	4,848
July	5,383	5,460	5,394	5,394	5,380
August	5,467	5,560	5,680	5,680	5,664
September	5,350	5,560	5,720	5,720	5,777
October	5,248	5,500	5,410	5,410	5,382
November	4,913	5,170	5,520	5,520	5,465
December	4,421	4,665	5,370	5,260	5,203
	54,527	53,976	53,705	53,595	54,299
1977					
January	4,288	4,635	5,460	5,090	5,159
February	4,312	5,005	5,880	5,730	5,748
March	4,354	5,305	6,070	6,360	6,050
April	4,576	5,475	6,230	6,350	6,117
May	4,958	5,535	6,500	6,310	6,122
June	4,914	5,520	6,500	6,330	6,255
July	4,847	5,460	6,510	6,320	6,380
August	4,961	5,310	6,560	6,350	6,206
September	4,547	5,060	6,490	6,350	5,678
October	4,295	4,505	6,270	5,620	4,997
November	3,899	3,585	5,130	5,140	4,642
December	3,190	2,695	3,630	4,020	4,069
	53,041	58,090	71,230	69,990	67,423

Source: Canadian Bechtel Limited Manpower Recruiting Reports and Project Statistics.

Table 3-8

Syncrude Project

Construction Manpower Requirements
Mildred Lake Site - All Crafts

Demand in Manmonths	Report Dated Nov/75 Feb/76	May/76	Jan/77	May/77	Actual
1978					
January	3,123	1,880	2,740	3,525	3,265
February	2,784	1,537	2,500	2,935	3,469
March	2,405	1,272	2,140	2,405	2,813
April	2,077	955	1,770	1,880	2,380
May	1,683	752	1,380	1,375	1,754
June	1,407	606	1,170	985	1,160
July	1,224	490	990	790	992
August	718	353	780	550	1,253
September	686	270	490	430	1,450
October	528	102	270	260	1,368
November	276	82	210	140	1,178
December	114	82	190	100	881
	17,025	8,381	14,630	15,375	21,963
Total Demand (Manmonths)	124,593	120,447	139,565	138,960	143,685
Supply in Manmonths					
Local	93,137	89,122	109,317	108,457	86,642
National	22,465	26,205	29,068	30,248	55,606
International	8,991	5,120	1,180	255	1,437
Total Supply (Manmonths)	124,593	120,447	139,565	138,960	143,685

Source: Canadian Bechtel Limited Manpower Recruiting Reports and Project Statistics.

	Initial Forecast	Actual Required	Per Cent Deviation
1976	54,527	54,299	(0.4)
1977	53,041	67,423	27.1
1978	17,025	21,963	29.0
Total	124,593	143,685	15.3

All estimates for the year 1976 are within 2.0 per cent of the initial forecast. Work carried out in this period was mainly basic construction and shop fabrication with little change in scope. The 1977 estimates exceed the initial forecast in every case, reaching a peak of 34.3 per cent over forecast at one point. Actual manmonths were 27.1 per cent over the original forecast. Overages were mainly due to acceleration of the completion schedule, offsetting decreases shown in the estimates for 1978 gradually diminished as extent of required changes became more apparent.

Actual manmonths for the year 1978 were considerably over the last estimate due to a timing carryover from 1977 and an abnormal amount of corrective work required before the plant could be operated.

Summary

Chapter III has described how the recruiting plan for the Syncrude project worked in actual practice and the significant effects of changes in Canadian economic conditions on the labour supply. Manpower analysts in the managing con-

tractor's office continually monitored labour conditions. Status of the labour demand-supply situation was communicated to project management by a series of formal recruiting reports. Slowdowns and postponements in the Canadian construction industry had a marked effect on Syncrude recruiting activities during the years 1975-1977. Softening labour market demands resulted in an increase in the voluntary flow of workers to the job site and reduced the need for international recruitment from a planned 15 per cent to less than one per cent.

Chapter IV develops manpower requirement profiles, similar to those shown for Syncrude, for the major construction projects currently planned for the near term period.

FOOTNOTES

[1] Data on actual performance was obtained from Canadian Bechtel Limited, Manpower Recruiting Reports, and Project Statistics, supplemented by discussions with Syncrude and Bechtel project personnel.

Chapter IV

POTENTIAL LARGE CONSTRUCTION PROJECTS 1978-1988

Introduction

In the early days of the Syncrude venture, there was much optimism as to the future development of many tar sand extraction plants. It was commonly expressed that construction of one plant would commence every two years. For example, The Long-Term Energy Assessment Program issued by the Alberta Oil Sands Environmental Research Program in 1975 outlines several different scenarios for timing of new construction of additional tar sands plants.[1] At that time scenario two of the assessment was considered the most probable level of construction. This case forecast 10-13 plants in production, with development taking place over a 20-year period. Sequential building of a series of plants, in the same area, using essentially similar construction techniques would neatly solve the problem of a skilled labour force. Crews would migrate from one project to the next as work progressed.

At the time of approval of the Syncrude project in 1973, three other consortiums headed respectively by Shell Canada Limited, Petrofina Canada Limited and Home Oil Company Limited had active applications pending for plant construction. Shell projected a 1976 construction start while

Petrofina and Home planned construction starts in 1978. Potential squeeze on the supply of skilled construction trades did not occur as the three planned projects were deferred for several reasons as noted below:

- Greater appreciation of technical and financial risks involved. It appeared that the industry was waiting until Syncrude went on stream so that performance relative to construction schedule, capital costs and production capability could be evaluated.

- Difficulty in arranging financial support. The larger than planned capital requirements made financing in the private sector difficult, necessitating possible government support. Lack of firm government policies in respect of guarantees as to price of synthetic crude oil, royalties and taxes add to investor apprehension as to a satisfactory rate of return.

- The remote locations of the other leases, 60 miles north of Fort McMurray, leads to a host of community related constraints. Questions of providing new infrastructures either through an efficient transportation system from Fort McMurray or by establishment of a new town site have to be resolved in cooperation with the federal and provincial governments.

- Possible limits to amount of construction activity that can take place at one time. This concern leads to two questions. The fact that construction of one plant requires a peak labour force in excess of 7,000 persons raised doubts

that the necessary skills are available in sufficient supply to construct two or more plants in concurrent or overlapping time frames. Concerns were also expressed that adequate community services can be created to support peak labour forces of this magnitude, i.e. 6,000 to 12,000 direct construction personnel plus owners' staff and related population growth.

At this point in time Petrofina and Home have shelved their plans indefinitely while the Shell sponsored development is in the process of public hearings before the Energy Resources Conservation Board. The Shell sponsored consortium, now called Alsands, in conjunction with recent developments in the heavy oil sector and the current tar sands plants has put the question of adequate construction manpower in a new perspective. State of the current industry-government environment is illustrated in a recent article by Dr. Lawrence J. Murphy, Senior Economist, Gulf Canada Limited, which states that, "Oil sands production has become an integral component of the oil supply picture because of the cooperative interest of industry and government in its development."[2] The same article states that, "Synthetic oil from the oil sands is expected to account for almost half of total domestic production by 2000. In effect, the roles of conventional and heavy and synthetic oils will be reversed by the end of the forecast period."[3] The foregoing view was expressed on an earlier occasion by Robert Peterson, Vice-President of

Esso Resources Canada Ltd. Peterson stated at an Energy Resources Conservation Board hearing that, "Half of Canada's domestic oil needs would be supplied by tar sands and heavy oil by the 1990's."[4] These statements reflect the new surge of interest in the non-conventional petroleum sector which has developed into a situation where Esso Resources and Alsands are potential competitors for construction workers within the same time frame. This chapter will identify currently planned major construction projects and will develop specific manpower requirements for each project and aggregate demand relationships. As the Syncrude complex has been used as the basis for many of the detailed calculations, an analysis of actual cost and manpower relationships has been included for this project.

Major projects. Government publications, industry releases and media reports were used to compile a list of 12 large construction projects in energy and related fields proposed for construction in the period 1980-1986. It was noted that no similar projects are projected after 1986. Selected projects as listed in Table 4-1 are deemed to be over and above normal construction activity and are analyzed in the following pages to provide detailed manpower demand data. Projects considered can be classified into five groups as follows:

	Number of Projects	Cost in Current Millions $
Petrochemical	2	365.0
Steel and Coal	3	148.0

Table 4-1

Construction Projects Planned for the Period
1980 - 1988

Description: Classification / Company	Project	Timing: Start	Timing: Complete	Estimated Cost Current Million Dollars
Petrochemicals				
Alberta Energy Corporation	Benzene Plant	Mid-1980	Mid-1983	225.0
	Synthetic Gas Plant	Mid-1980	Mid-1983	140.0
				365.0
Coal and Steel				
Irving Industries Ltd.	Steel Foundry	1980	1981	8.0
Forestburg Collieries	Thermal Coal Processing Plant	Jan., 1980	Jan., 1982	40.0
Union Oil Co.	Thermal Coal Processing Plant	1982	1984	100.0
				148.0
Heavy Oil Extraction				
Esso Resources Ltd.	Extraction Plant	Mid-1981	Mid-1986	2500.0
Tar Sands Extraction				
Great Canadian Oil Sands	Expansion	July, 1979	Mid-1982	185.0
Syncrude Canada Ltd.	Debottleneck	1981	1983	100.0
	Expansion	Mid-1982	Mid-1986	2290.0
Alsands	Tar Sands Plant	Mid-1981	Mid-1986	4900.0
				7475.0
Natural Gas Pipelines				
Alcan Pipeline	Canadian Portions	May, 1980	Oct., 1984	5786.0
	Dempster Lateral	1985	1987	2088.0
Polar Gas Ltd.	Arctic Pipelines	Mid-1982	1986	7000.0
				14874.0
	TOTAL VALUE IN CURRENT MILLIONS OF DOLLARS			25362.0

Source: List of Industrial Projects. Alberta Department of Development and Tourism. January, 1979.

	Number of Projects	Cost in Current Millions $
Tar Sands Extraction	4	7471.7
Heavy Oil Extraction	1	4450.0
Natural Gas Pipelines	2	14874.0
Total Projects	12	27308.7

Planned construction periods are shown in Table 4-2; expenditure profiles, in current and constant dollars, are shown in Tables 4-3 and 4-4 respectively. Individual project descriptions and cost/manpower relationships are developed in the following sections.

Constant Dollars

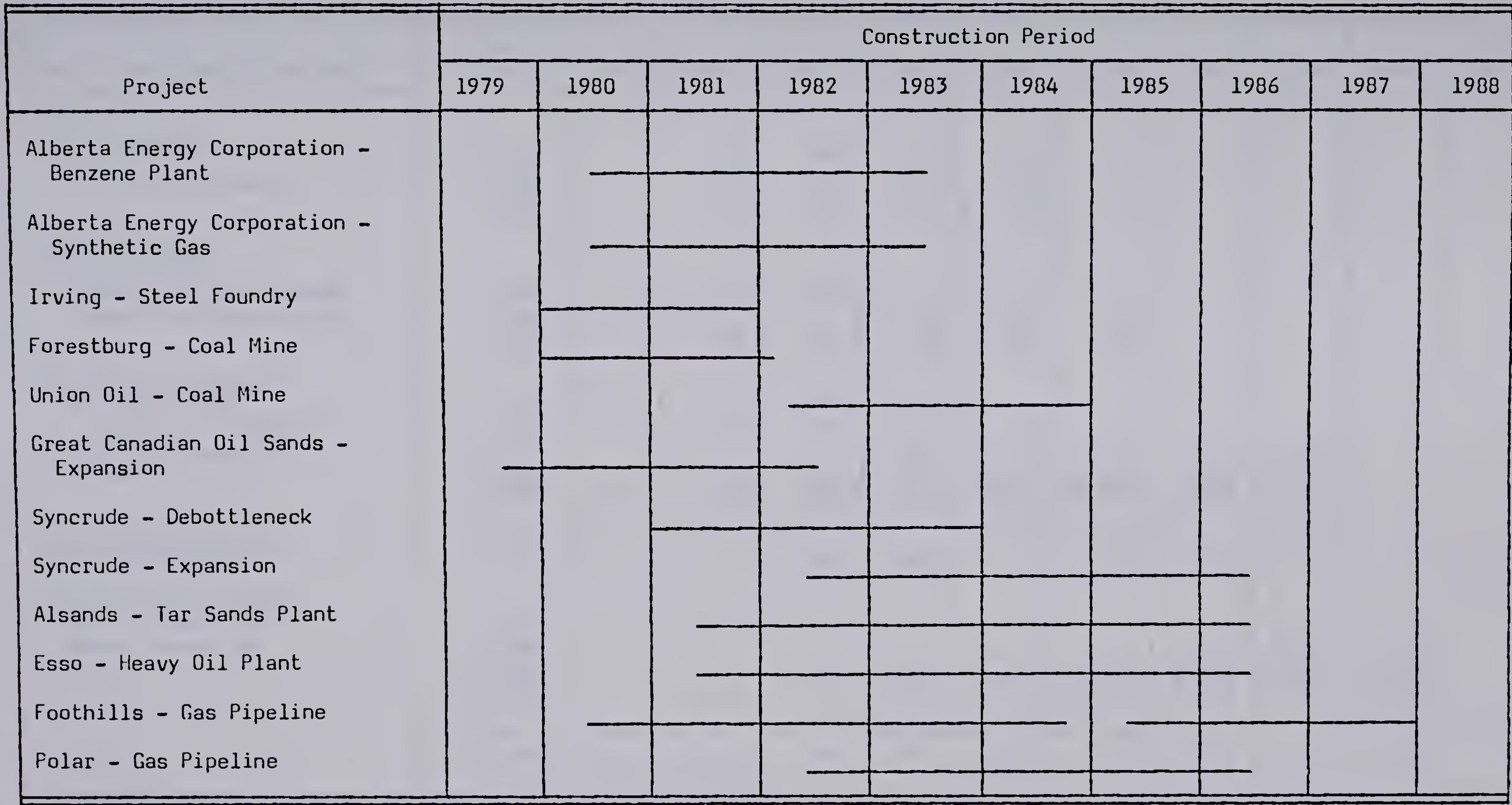
Total project costs are usually quoted in terms of total expenditures required to complete the facility. In the case of large projects extending over several years in the future, failure to recognize inflationary trends could lead to distortion of manpower projections based on expenditure profiles. This effect has been reduced by conversion of all current year costs to constant 1977 dollars by use of the conversion factors shown in Table 4-5.

Syncrude Canada Ltd.

The most outstanding example to date in Alberta of the labour demand generated by a large project is the Syncrude complex recently completed at Mildred Lake. Construction started in late 1973 and continued through December 1978. Scope of construction considered in this study includes mining

Table 4-2

Large Projects - Planned Construction Schedules



Derived from Table 4-1.

Table 4-3

Construction Expenditure Profiles

Current Millions of Dollars	Total Cost	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Petrochemicals											
Benzene Plant	225		20	60	90	55					
Synthetic Gas Plant	140		14	42	49	35					
	365		34	102	139	90					
Coal and Steel											
Steel Foundry	8		3	5							
Thermal Coal Processing	40		15	25							
Thermal Coal Processing	100				30	45	25				
	148		18	30	30	45	25				
Tar Sands Extraction											
GCOS Expansion	185	19	56	74	36						
Syncrude Debottleneck	100		3	40	47	10					
Syncrude Expansion	2,290				183	527	779	595	206		
Alsands Project	4,900			245	980	1,715	1,176	588	196		
	7,475	19	59	359	1,246	2,252	1,955	1,183	402		
Heavy Oil Extraction											
Esso Resources	2,500			200	450	725	625	375	125		
Natural Gas Pipelines											
Alcan - Canadian	5,786		1,175	1,173	1,719	1,719					
Alcan - Dempster	2,088							522	1,044	522	
Polar	7,000						1,050	2,240	2,310	1,400	
	14,874		1,175	1,173	1,719	1,719	1,050	2,762	3,354	1,922	
Total	25,362	19	1,286	1,864	3,584	4,831	3,655	4,320	3,881	1,922	

Derived from Table 4-1.

Table 4-4

Construction Expenditure Profiles

Constant Millions of Dollars (1977 Dollars)	Total Cost	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Petrochemicals											
Benzene Plant	159		16	45	62	36					
Synthetic Gas Plant	99		11	31	34	23					
	258		27	76	96	59					
Coal and Steel											
Steel Foundry	6		2	4							
Thermal Coal Processing	31		12	19							
Thermal Coal Processing	65				21	29	15				
	102		14	23	21	29	15				
Tar Sands Extraction											
GCOS Expansion	140	16	44	55	25						
Syncrude Debottleneck	72		2	30	33	7					
Syncrude Expansion	1,399				127	341	476	343	112		
Alsands Project	3,136			182	679	1,111	718	339	107		
	4,747	16	46	267	864	1,459	1,194	682	219		
Heavy Oil Extraction											
Esso Resources	1,596			148	312	470	382	216	68		
Natural Gas Pipelines											
Alcan - Canadian	4,107		933	870	1,191	1,113					
Alcan - Dempster	1,137							301	568	268	
Polar	3,905						641	1,290	1,256	718	
	9,149		933	870	1,191	1,113	641	1,591	1,824	986	
Total	15,852	16	1,020	1,384	2,484	3,130	2,232	2,489	2,111	986	

Derived from Table 4-1.

Table 4-5

Cost Conversion Factors

Year	Percentage Change in Index	Implicit Price Index	Conversion Factor
1974	15.8	136.1	132.0
1975	10.5	150.4	119.5
1976	10.2	165.7	108.4
1977	8.4	179.7	100.0
1978	9.0	195.9	0.9173
1979	8.0	211.6	0.8492
1980	7.0	226.4	0.7937
1981	7.0	242.3	0.7416
1982	7.0	259.3	0.6930
1983	7.0	277.5	0.6476
1984	6.0	294.2	0.6108
1985	6.0	311.9	0.5761
1986	6.0	330.6	0.5436
1987	6.0	350.4	0.5128
1988	6.0	371.5	0.4837

Inflators:

Based on implicit price indexes per Table 8.1 non-residential price indexes, Construction Price Statistics, Statistics Canada. Catalogue No. 62-007, June 1978.

Deflators:

Based on projected annual percentage changes in the non-residential price index.

operation facilities, extraction and upgrading plants, utility plant and storage tankage. Costs were 2,002.7 million in constant 1977 dollars and manual labour requirements were 194,454 manmonths. Over the 62-month length of the project, average number of tradesmen employed was 3,236, with a peak of 6,567 during the month of August, 1976. Expenditure profiles, manpower profiles and construction costs per manmonth are shown in Tables 4-6, 4-7 and 4-8.

In order to minimize the Mildred Lake labour force, extensive use was made of pre-assembly operations in the Edmonton area. Associated manpower data are included in the applicable tables.

Because of similarities in plant type, location, construction methods and execution schedules Syncrude cost-labour ratios and craft mix have been used as models for several of the projects included in this study in the following ways:

1. In certain cases execution schedules have been patterned after Syncrude in terms of per cent of total cost expended each year.

2. Manpower levels and mix have been calculated by application of Syncrude factors for costs per man year and craft distribution.

Syncrude plant construction was carried out on a scheduled 48 hour week and all calculations for planned projects have been based on this assumption; however, as current Department of Labour permits only allow a scheduled 40 hour work week, data has also been adjusted to show the effect of the shorter work week. The ramifications of shortened work week are discussed in Chapter V.

Table 4-6

Syncrude Construction Cost Profile
(millions of dollars)

Year		Current Dollars	1977 Dollars	
1974		120		158.4
1975	Q1	53	63.3	
	Q2	75	89.6	
	Q3	115	137.4	
	Q4	138	164.9	455.2
1976	Q1	132	143.1	
	Q2	160	173.4	
	Q3	167	181.0	
	Q4	166	179.9	677.4
1977	Q1	143	143.0	
	Q2	149	149.0	
	Q3	127	127.0	
	Q4	101	101.0	520.0
1978	Q1	65	59.6	
	Q2	56	51.4	
	Q3	48	44.0	
	Q4	40	36.7	191.7
		1,855		2,002.7

Actual construction work, excluding preproduction costs, mobile equipment, chemicals and catalysts, shop tools and equipment, working capital and town development.

Source: Syncrude Construction Reports.

Table 4-7

Syncrude Project

Cost - Manpower Relationships

Year	Expenditures (Millions of 1977 Dollars)	Average Annual Construction Force		Expenditures (Thousands of Dollars per Man-Year)	
		48 Hr. Wk.	40 Hr. Wk.	48 Hrs.	40 Hrs.
1974	158.4	796	955	199.0	165.9
1975	455.2	2,492	2,990	182.7	152.2
1976	677.4	5,171	6,205	131.0	109.2
1977	520.0	5,881	7,057	88.4	73.7
1978	191.7	1,840	2,208	104.2	86.8
Aggregate	2,002.7	16,180	19,415	N/A	N/A
Average	N/A	3,236	3,883	123.8	103.2

Source: Syncrude Construction Statistics.

Table 4-8

Syncrude Project

Craft Mix

Average Per Cent Per Year

Craft	Year 1	Year 2	Year 3	Year 4	Year 5	Project Average
Boilermakers	2.4	5.0	6.5	2.1	1.8	4.0
Carpenters	10.3	10.3	8.1	5.0	5.6	7.1
Cement Masons	-	0.1	0.1	-	0.1	0.1
Electricians	5.1	6.6	10.6	18.5	16.4	13.2
Insulators	-	-	0.5	6.8	24.2	5.4
Ironworkers	5.4	8.2	8.6	6.4	4.5	7.1
Labourers	20.8	21.9	16.1	8.7	11.3	13.9
Millwrights	-	0.1	1.3	2.4	2.6	1.6
Operating Engineers	40.4	26.6	19.2	12.3	9.4	17.8
Pipefitters/Pipefitters Welders	3.8	8.3	17.9	30.2	16.5	20.0
Sheet Metal Workers	-	0.1	1.3	1.8	2.0	1.3
Teamsters	7.6	7.4	6.9	4.5	5.2	6.0
Other	4.2	5.4	2.9	1.3	0.4	2.5
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: Syncrude Construction Statistics.

Example calculation. As stated earlier, the Syncrude project has been used as a model for calculation of manpower requirements for certain similar projects. An example of such a calculation is the Alsands project. The following steps illustrate the process used to convert the published construction cost of 4900 millions of current dollars for this plant to an equivalent construction force as shown in Table 4-9:

1. Expenditure profile - Total current cost converted to annual expenditures by reference to the Syncrude expenditure pattern shown in Table 4-6.

2. Constant dollars - Expenditure profile in current dollars converted to constant 1977 dollars by application of deflation factors from Table 4-5.

3. Average annual workforce - Average annual workforce is derived by dividing labour factor for the applicable stage of construction, from Table 4-7, into the constant dollar expenditures for that year.

The labour factors, as shown for the Syncrude project in Table 4-7, were calculated by dividing the actual average yearly workforce into construction expenditures to arrive at a relationship of actual labour requirements to actual expenditures.

4. Work week - Workforce levels were calculated for both 40 and 48 hour work weeks.

5. Craft requirements - Craft requirements were calculated by application of craft mix percentages for the appropriate year from Table 4-8.

Table 4-9

Calculation Example

Alsands Project Expenditure Profile
(Millions of Dollars)

Year	Percent	Current Dollars	Deflator	Constant Dollars
1981	5	245	.7416	182
1982	20	980	.6930	679
1983	35	1,715	.6476	1,111
1984	24	1,176	.6108	718
1985	12	588	.5761	339
1986	4	196	.5436	107
	100	4,900		3,136

Source: Tables 4-5 and 4-6.

The following pages show the expenditure and labour requirement profiles for each classification of the major projects considered in this study. Summaries of craft requirements are contained in Appendix C.

Petrochemical Projects

The only major petrochemical projects announced for the near term period are a benzene plant and a synthetic gas plant to be constructed in the Edmonton area by Alberta Energy Company Ltd.[5] As location and timing are identical, construction will likely take place on an integrated basis with a single contractor. Due to the type of facilities involved labour demand is assumed to be one and one-quarter times that of Syncrude average manning per $1,000 of investment in constant 1977 dollars. The craft mix is assumed to be similar to Syncrude.

Expenditure and manpower demand profiles are shown in Tables 4-10, 4-11 and 4-12.

Coal and Steel Projects

Three large construction projects in this category, planned for the period under review, were deemed to be over normal construction activity.[6] Labour demand and craft mix is based on industry standards for these types of projects.

Expenditure and manpower profiles are shown in Tables 4-13, 4-14 and 4-15.

Tar Sands Extraction

There are four major projects planned for this sector

Table 4-10

Petrochemical Projects
Construction Profile

Year	Cost (Millions of Dollars) Current	Constant	Labour Factor**	Total Manpower 48 Hour Week	40 Hour Week
1980	34	27	99.0	273	328
1981	102	76	99.0	768	920
1982	139	96	99.0	968	1,162
1983	90	59	99.0	596	715
Total	365	258	99.0	2,605	3,125

** Eighty per cent of average Syncrude project construction expenditure in thousands of constant dollars per manyear based on a scheduled workweek of 48 hours.

Table 4-11

Petrochemical Projects

Craft Requirements
48 Hour Week

Craft	1980	1981	1982	1983	Total
Boilermakers	11	31	39	24	105
Carpenters	19	55	68	42	184
Electricians	36	101	128	79	344
Insulators	15	40	52	32	139
Ironworkers	19	55	69	42	185
Labourers	38	107	135	83	363
Millwrights	4	12	15	10	41
Operating Engineers	49	137	172	106	464
Pipefitter Welders/ Pipefitters	55	154	194	119	522
Sheet Metal Workers	4	10	13	8	35
Teamsters	16	46	58	36	156
Others	7	20	25	15	67
Total	273	768	968	596	2,605

Table 4-12

Petrochemical Projects

Craft Requirements

40 Hour Week

Craft	1980	1981	1982	1983	Total
Boilermakers	13	37	47	29	126
Carpenters	23	66	82	50	221
Electricians	43	121	154	95	413
Insulators	18	48	62	38	166
Ironworkers	23	66	83	50	222
Labourers	46	128	162	100	436
Millwrights	5	14	18	12	49
Operating Engineers	59	164	205	127	555
Pipefitter Welders/ Pipefitters	66	185	233	143	627
Sheet Metal Workers	5	12	16	10	43
Teamsters	19	55	70	43	187
Others	8	24	30	18	80
Total	328	920	1,162	715	3,125

Table 4-13

Coal and Steel Projects
Construction Profile

Year	Cost (Millions of Dollars) Current	Constant	Labour Factor**	Total Manpower 48 Hour Week	40 Hour Week
1980	18	14	123.8	113	136
1981	30	23	123.8	186	223
1982	30	21	123.8	170	204
1983	45	29	123.8	234	281
1984	25	15	123.8	121	145
Total	148	102	123.8	824	989

** Average Syncrude project construction expenditure in thousands of constant dollars per manyear based on a scheduled workweek of 48 hours.

Table 4-14

Coal and Steel Projects

Craft Requirements

48 Hour Week

Craft	1980	1981	1982	1983	1984	Total
Boilermakers	17	27	25	35	18	122
Carpenters	3	5	4	6	3	21
Electricians	3	5	4	6	3	21
Ironworkers	38	64	58	80	41	281
Labourers	8	13	12	16	8	57
Millwrights	12	19	18	24	12	85
Operating Engineers	10	17	16	20	12	75
Pipefitter Welders/ Pipefitters	17	28	26	36	19	126
Teamsters	4	7	6	9	4	30
Others	1	1	1	2	1	6
Total	113	186	170	234	121	824

Table 4-15

Coal and Steel Projects

Craft Requirements

40 Hour Week

Craft	1980	1981	1982	1983	1984	Total
Boilermakers	20	32	30	42	22	146
Carpenters	4	6	5	7	4	26
Electricians	4	6	5	7	4	26
Ironworkers	46	77	70	96	48	337
Labourers	10	16	14	19	10	69
Millwrights	14	23	22	29	14	102
Operating Engineers	12	20	19	24	14	89
Pipefitter Welders/ Pipefitters	20	34	31	43	23	151
Teamsters	5	8	7	11	5	36
Others	1	1	1	3	1	7
Total	136	223	204	281	145	989

of the industry, three as a direct result of the successful completion of the Syncrude project. The projects included in this study are:

Great Canadian Oil Sands, expansion to increase production by 13,000 barrels per day.[7]

Syncrude, debottleneck work to increase production by 20,000 barrels per day.[8]

Syncrude, expansion to increase production by 55,000 barrels per day.[9]

Alsands project, a nine-company consortium headed by Shell Canada has an application before the Alberta Energy Resources Conservation Board to construct 4.9 billion dollar oil sands extraction plant north of Fort McMurray.[10] The proposed plant will have a production capacity of 140,000 barrels per day of synthetic crude and liquified petroleum gases. The complex will be similar in mining plan, process technology and scale to the Syncrude project.

Separate tables (4-16 to 4-24 inclusive), as shown on the following pages, have been developed for expansion projects (Great Canadian Oil Sands, Syncrude debottleneck), Syncrude expansion and Alsands.

Heavy Oil Extraction

Disappointing results in exploratory drilling programs for conventional crude oil in the high Arctic have caused interest to be focussed on development of heavy oil deposits, particularly since long-term laboratory and field

Table 4-16

Tar Sands Extraction - Expansion Projects
(GCOS Expansion - Syncrude Debottleneck)

Construction Profile

Year	Cost (Millions of Dollars) Current	Cost (Millions of Dollars) Constant	Labour Factor**	Total Manpower 48 Hour Week	Total Manpower 40 Hour Week
1979	19	16	123.8	129	155
1980	59	46	123.8	372	446
1981	114	85	123.8	687	824
1982	83	58	123.8	468	562
1983	10	7	123.8	56	67
Total	285	212	123.8	1,712	2,054

** Average Syncrude project construction expenditure in thousands of constant dollars per manyear based on a scheduled workweek of 48 hours.

Craft requirements are based on Syncrude average.

Table 4-17

Tar Sand Extraction - Expansion Projects

Craft Requirements

48 Hour Week

Craft	1979	1980	1981	1982	1983	Total
Boilermakers	5	15	27	19	2	68
Carpenters	9	26	49	33	4	121
Electricians	17	49	91	62	7	226
Insulators	7	20	37	25	3	92
Ironworkers	9	26	49	33	4	121
Labourers	18	53	95	65	8	239
Millwrights	2	6	12	8	1	29
Operating Engineers	23	66	122	83	10	304
Pipefitter Welders/ Pipefitters	26	74	137	94	11	342
Sheet Metal Workers	2	5	9	6	1	23
Teamsters	8	22	41	28	3	102
Others	3	10	18	12	2	45
Total	129	372	687	468	56	1,712

Table 4-18

Tar Sands Extraction - Expansion Projects

Craft Requirements

40 Hour Week

Craft	1979	1980	1981	1982	1983	Total
Boilermakers	6	18	32	23	2	81
Carpenters	11	31	59	40	5	146
Electricians	20	59	109	74	8	270
Insulators	8	24	44	30	4	110
Ironworkers	11	31	59	40	5	146
Labourers	22	64	114	77	10	287
Millwrights	2	7	14	10	1	34
Operating Engineers	28	79	146	100	12	365
Pipefitter Welders/ Pipefitters	31	89	164	113	13	410
Sheet Metal Workers	2	6	12	7	1	28
Teamsters	10	26	49	34	4	123
Others	4	12	22	14	2	54
Total	155	446	824	562	67	2,054

Table 4-19

Tar Sands Extraction - Syncrude Expansion
Construction Profile

Year	Cost (Millions of Dollars) Current	Constant	Labour Factor**	Total Manpower 48 Hour Week	40 Hour Week
1982	183	127	199.0	638	766
1983	527	341	182.7	1,866	2,239
1984	779	476	131.0	3,634	4,361
1985	595	343	88.0	3,880	4,656
1986	206	112	104.2	1,075	1,290
Total	2,290	1,399	126.1	11,093	13,312

** Staged Syncrude project construction expenditures in thousands of constant dollars per manyear based on a scheduled workweek of 48 hours.

Craft requirements are based on Syncrude experience for each year of construction.

Table 4-20

Tar Sands Extraction - Syncrude Expansion

Craft Requirements

48 Hour Week

Craft	1982	1983	1984	1985	1986	Total
Boilermakers	15	93	236	81	19	444
Carpenters	66	192	294	194	60	806
Electricians	33	123	385	718	176	1,435
Insulators	--	--	18	264	260	542
Ironworkers	34	153	313	248	48	796
Labourers	133	409	585	338	121	1,586
Millwrights	--	2	48	93	28	171
Operating Engineers	258	496	698	477	101	2,030
Pipefitter Welders/ Pipefitters	24	155	650	1,172	179	2,180
Sheet Metal Workers	--	2	47	70	22	141
Teamsters	48	138	251	175	56	668
Others	27	103	109	50	5	294
Total	638	1,866	3,634	3,880	1,075	11,093

Table 4-21

Tar Sands Extraction - Syncrude Expansion

Craft Requirements

40 Hour Week

Craft	1982	1983	1984	1985	1986	Total
Boilermakers	18	112	283	97	23	533
Carpenters	79	230	353	233	72	967
Electricians	40	148	462	862	211	1,723
Insulators	--	--	22	317	312	651
Ironworkers	41	184	376	298	58	957
Labourers	160	490	702	405	145	1,902
Millwrights	--	2	58	112	34	206
Operating Engineers	310	595	838	572	121	2,436
Pipefitter Welders/ Pipefitters	28	186	780	1,406	215	2,615
Sheet Metal Workers	--	2	56	84	26	168
Teamsters	58	166	300	210	67	801
Others	32	124	131	60	6	353
Total	766	2,239	4,361	4,656	1,290	13,312

Table 4-22

Tar Sands Extraction - Alsands Project
Construction Profile

Year	Cost (Millions of Dollars) Current	Constant	Labour Factor**	Total Manpower 48 Hour Week	40 Hour Week
1981	245	182	199.0	915	1,098
1982	980	679	182.7	3,716	4,459
1983	1,715	1,111	131.0	8,481	10,177
1984	1,176	718	88.4	8,122	9,746
1985	588	339	104.2	3,253	3,904
1986	196	107	104.2	1,027	1,232
Total	4,900	3,136	122.9	25,514	30,616

** Staged Syncrude project construction expenditures in thousands of constant dollars per manyear based on a scheduled workweek of 48 hours.

Craft requirements are based on Syncrude experience for each year of construction.

Table 4-23

Tar Sands Extraction - Alsands Project

Craft Requirements

48 Hour Week

Craft	1981	1982	1983	1984	1985	1986	Total
Boilermakers	22	186	554	170	59	18	1,009
Carpenters	94	383	687	406	182	58	1,810
Electricians	47	245	899	1,503	533	168	3,395
Insulators	--	--	42	552	787	249	1,630
Ironworkers	49	305	729	520	146	46	1,795
Labourers	190	814	1,365	707	368	116	3,560
Millwrights	--	4	110	195	85	27	421
Operating Engineers	370	988	1,628	999	306	97	4,388
Pipefitter Welders/ Pipefitters	35	308	1,518	2,453	537	169	5,020
Sheet Metal Workers	--	4	110	146	65	21	346
Teamsters	70	275	585	365	169	53	1,517
Others	38	204	254	106	16	5	623
Total	915	3,716	8,481	8,122	3,253	1,027	25,514

Table 4-24

Tar Sands Extraction - Alsands Project

Craft Requirements

40 Hour Week

Craft	1981	1982	1983	1984	1985	1986	Total
Boilermakers	26	223	665	204	71	22	1,211
Carpenters	113	460	824	487	218	70	2,172
Electricians	56	294	1,078	1,804	640	202	4,074
Insulators	--	--	50	662	944	299	1,955
Ironworkers	59	364	875	624	175	55	2,152
Labourers	228	977	1,638	848	442	138	4,271
Millwrights	--	5	132	234	102	32	505
Operating Engineers	444	1,186	1,954	1,199	368	116	5,267
Pipefitter Welders/ Pipefitters	42	370	1,822	2,944	644	203	6,025
Sheet Metal Workers	--	5	132	175	78	25	415
Teamsters	84	330	702	438	203	64	1,812
Others	46	245	305	127	19	6	748
Total	1,098	4,459	10,177	9,746	3,904	1,232	30,616

research have improved extraction techniques to the point where commercial sized plants now appear viable.

Deposits stretch across the Alberta-Saskatchewan border in the northern part of the provinces. The Cold Lake, Lloydminster, Viking-Kinsella and Wainwright heavy oil fields presently produce 200,000 barrels per day for asphalt production, Canadian refinery energy requirements and for export. Industry, for reasons stated above, is now actively moving towards extraction and processing of heavy oil for conventional uses. Husky Oil Ltd., Pacific Petroleums Limited and Imperial Oil Limited have had projects in the planning stages for some time but only the Imperial Oil project is far enough advanced to be included in this study.

Esso Resources Canada, Ltd., a wholly owned subsidiary of Imperial Oil currently has an application before the Alberta Energy Resources Conservation Board. Esso Resources proposes to build an upgrading plant capable of producing 140,000 barrels per day of upgraded crude oil in the Cold Lake region where the company has been conducting research for many years.

Feed for the plant will be bitumen obtained from the sand formation by the insitu steam injection process.[11] Total cost for the project including drilling of injection and production wells, upgrading facilities and utilities plant is estimated 4.5 billion dollars.[12] Construction is expected to start in mid-1981 with completion scheduled for early 1986.[13]

Estimated costs of 2.5 billion dollars, relating to the upgrading and utility facilities, have been used in this study. Additional expenditures of 2.0 billion dollars for well drilling, to be phased in over the 20-year life of the project, have been excluded.[14] Investment and manpower relationships, as shown in Tables 4-25, 4-26 and 4-27 have been assumed to be similar to Syncrude.

Natural Gas Pipelines

Due to their potential impact on certain crafts, the two proposed transcontinental natural gas pipelines have been included in this study.

Alcan pipeline. The overall length of the Alcan pipeline from Prudhoe Bay, Alaska to terminals in the mid United States is 5,500 miles, including a 730-mile lateral along the Dempster Highway to the Mackenzie Delta. Basic cost plus overruns is estimated at 15.7 billion current dollars or approximately 2.9 billion dollars per mile.[15] The Canadian portion only, including the Dempster lateral, has been considered. This section reaching from Alaska to the southern border is 2,023 miles in length and will cost in the order of 5800 billion dollars.

Present plans call for completion of the main line by late 1984, the southern portion would be pre-constructed during 1980 and 1981 and the Dempster lateral would be built after 1985. This plan allows for short-term exports of Alberta gas to markets in the Western United States by the fall of 1980 and to the Chicago area by the fall of 1981.[16] Proposed

Table 4-25

Heavy Oil Extraction - Esso Resources
Construction Profile

Year	Cost (Millions of Dollars) Current	Constant	Labour Factor**	Total Manpower 48 Hour Week	40 Hour Week
1981	200	148	199.0	744	893
1982	450	312	182.7	1,708	2,050
1983	725	470	131.0	3,588	4,306
1984	625	382	88.4	4,321	5,185
1985	375	216	104.2	2,073	2,488
1986	125	68	104.2	653	784
Total	2,500	1,596	122.0	13,087	15,706

** Staged Syncrude project construction expenditures in thousands of constant dollars per manyear based on a scheduled workweek of 48 hours.

Craft requirements are based on Syncrude experience for each year of construction.

Table 4-26

Heavy Oil Extraction - Esso Resources

Craft Requirements

48 Hour Week

Craft	1981	1982	1983	1984	1985	1986	Total
Boilermakers	18	85	233	91	37	12	476
Carpenters	77	176	290	216	116	37	912
Electricians	38	113	380	799	340	107	1,777
Insulators	--	--	18	294	503	158	973
Ironworkers	40	140	308	277	93	29	887
Labourers	155	374	578	376	234	74	1,791
Millwrights	--	3	47	104	54	17	225
Operating Engineers	301	454	689	531	195	61	2,231
Pipefitter Welders/ Pipefitters	28	142	642	1,305	342	108	2,567
Sheet Metal Workers	--	3	47	78	41	13	182
Teamsters	57	126	248	194	108	34	767
Others	30	92	108	56	10	3	299
Total	744	1,708	3,588	4,321	2,073	653	13,087

Table 4-27

Heavy Oil Extraction - Esso Resources

Craft Requirements

40 Hour Week

Craft	1981	1982	1983	1984	1985	1986	Total
Boilermakers	22	102	280	109	44	14	571
Carpenters	92	211	347	259	139	44	1,092
Electricians	46	136	456	959	408	128	2,133
Insulators	--	--	22	353	604	190	1,169
Ironworkers	48	168	370	332	112	35	1,065
Labourers	186	449	694	451	281	89	2,150
Millwrights	--	4	56	125	65	20	270
Operating Engineers	361	545	827	637	234	73	2,677
Pipefitter Welders/ Pipefitters	34	170	770	1,566	410	130	3,080
Sheet Metal Workers	--	4	56	94	49	16	219
Teamsters	68	151	298	233	130	41	921
Others	36	110	130	67	12	4	359
Total	893	2,050	4,306	5,185	2,488	784	15,706

schedule calls for completion of 38 per cent of the Alberta section and the 105-mile southern British Columbia section in 1980 and completion of another 31 per cent of the Alberta section plus all the Saskatchewan section in 1981. The northern Alberta and British Columbia sections and the Yukon section would be constructed in the period mid-1981 to mid-1983. The Dempster lateral to the Mackenzie Delta would not be built until the 1985-87 period. Construction mileage, costs, schedules and manpower profiles for the Canadian sections are shown in Tables 4-28 to 4-35, inclusive.

Manpower aggregate and craft requirements have been calculated from data provided by the Planning Secretariat, Alberta Department of Advanced Education and Manpower. Estimate is based on an average of 1,448 men per season to construct a 403-mile section.

Polar gas pipeline. A consortium composed of Panarctic Oils, Trans-Canada Pipe Lines, Ontario Energy Corporation and Tenneco Oil of Canada plan to construct a natural gas pipeline from the high Arctic to feed into the present Trans-Canada Pipe Lines system in southern Canada.[17] Route of the pipeline has not been settled as two alternatives are being considered, the original route which runs directly south to Longlac, Ontario, with several ocean crossings or a proposed "Y" system through Coppermine, with a lateral from the Mackenzie Delta, then running south-east to Winnipeg or Longlac.[18] The Polar Gas group has stated that costs of either route would be 7.0 billion dollars.[19] Construction will take 4-5

Table 4-28

Alaska Highway Gas Pipeline

(Alcan)

Cost Profile

Section	Length Miles	Original Estimate (Millions $)	Current Estimate (Millions $)
Alaska	730	1,180	2,088
Yukon	512	826	1,464
British Columbia	545	880	1,559
Alberta	806	1,300	2,305
Saskatchewan	160	258	458
Delta	730	1,180	2,088
Southern U.S.	2,000	3,226	5,720
	5,483	8,850	15,682

Table 4-29

Alaska Highway Gas Pipeline
(Alcan)

Construction Schedule - Canadian Section

Year	Section	Miles	Cost (Millions $)
1980	Alberta Central and West	306	875
	British Columbia South	105	300
		411	1,175
1981	Alberta East	250	715
	Saskatchewan	160	458
		410	1,173
1982-83	Alberta North	250	715
	British Columbia		
	North	440	1,259
	Yukon	512	1,464
		1,202	3,438
Total		2,023	5,786

Table 4-30

Alcan Pipeline - Canadian Sections
Construction Profile

Year	Cost (Millions of Dollars)		Mileage	Total Manpower	
	Current	Constant		48 Hour Week	40 Hour Week
1980	1,175	933	411	1,477	1,772
1981	1,173	870	410	1,473	1,768
1982	1,719	1,191	601	2,159	2,591
1983	1,719	1,113	601	2,159	2,591
Total	5,786	4,107	2,023	7,268	8,722

Table 4-31

Alcan Pipeline - Canadian Sections

Craft Requirements

48 Hour Week

Crafts	1980	1981	1982	1983	Total
Carpenters	117	117	171	171	576
Electricians	160	160	233	233	786
Insulators	84	84	123	123	414
Labourers	328	328	479	479	1,614
Millwrights	28	28	41	41	138
Operating Exgineers	360	360	527	527	1,774
Pipefitter Welders/ Welders	193	193	283	283	952
Teamsters	189	189	276	276	930
Others	18	14	26	26	84
Total	1,477	1,473	2,159	2,159	7,268

Table 4-32

Alcan Pipeline - Canadian Sections

Craft Requirements

40 Hour Week

Craft	1980	1981	1982	1983	Total
Carpenters	140	140	205	205	690
Electricians	192	192	280	280	944
Insulators	100	100	148	148	496
Labourers	394	394	575	575	1,938
Millwrights	34	34	49	49	166
Operating Engineers	432	432	632	632	2,128
Pipefitter Welders/ Pipefitters	232	232	340	340	1,144
Teamsters	227	227	331	331	1,116
Others	21	17	31	31	100
Total	1,772	1,768	2,591	2,591	8,722

Table 4-33

Alcan Pipeline - Dempster Lateral
Construction Profile

Year	Cost (Millions of Dollars) Current	Constant	Mileage	Total Manpower 48 Hour Week	40 Hour Week
1985	522	301	182	656	787
1986	1,044	568	365	1,311	1,573
1987	522	268	183	656	787
Total	2,088	1,137	730	2,623	3,147

Table 4-34

Alcan Pipeline - Dempster Lateral

Craft Requirements
48 Hour Week

Craft	1985	1986	1987	Total
Carpenters	52	104	52	208
Electricians	71	142	71	284
Insulators	37	74	37	148
Labourers	146	292	146	584
Millwrights	12	24	12	48
Operating Engineers	160	320	160	640
Pipefitter Welders/ Pipefitters	86	172	86	344
Teamsters	84	168	84	336
Others	8	15	8	31
Total	656	1,311	656	2,623

Table 4-35

Alcan Pipeline - Dempster Lateral

Craft Requirements
40 Hour Week

Craft	1985	1986	1987	Total
Carpenters	62	124	62	248
Electricians	85	170	85	340
Insulators	44	88	44	176
Labourers	175	350	175	700
Millwrights	14	28	14	56
Operating Engineers	192	384	192	768
Pipefitter Welders/ Pipefitters	103	206	103	412
Teamsters	101	202	101	404
Other	11	21	11	43
Total	787	1,573	787	3,147

years and probably will not start until mid-1984. Construction mileage, costs, schedule and manpower profiles are shown in Tables 4-36 to 4-39, inclusive.

Manpower aggregate and craft requirements have been calculated from data provided by the Planning Secretariat, Alberta Department of Advanced Education and Manpower. Estimate is based on an average of 1,448 men per season to construct a 403-mile section.

Summary

Purpose of this chapter has been to develop estimates of construction manpower requirements for major projects planned for execution in Alberta during the period covered by this study.

As the Syncrude project has been used as a basis for many of the calculations, pertinent details of cost-manpower relationships have been shown.

Average annual manpower requirements, summarized by type of project, are shown in Tables 4-40 and 4-41 for both 48 and 40 hour schedule work weeks. Annualized tables have been further detailed in terms of individual craft requirements and are contained in Appendix C.

It should be noted that the aforementioned tables do not include manpower requirements for the proposed Polar natural gas pipeline. While it is thought appropriate to identify the proposed Polar pipeline schedule and associated manpower requirements in the text, data was excluded from the

Table 4-36

Polar Gas Pipeline
Construction Schedule

Year	Cost (Millions $)
1984	1,050
1985	2,240
1986	2,310
1987	1,400
Total	7,000

Table 4-37

Polar Gas Pipeline
Construction Profile

Year	Cost (Millions of Dollars) Current	Constant	Mileage	Total Manpower 48 Hour Week	40 Hour Week
1984	1,050	641	350	1,257	1,508
1985	2,240	1,290	748	2,687	3,224
1986	2,310	1,256	772	2,774	3,329
1987	1,400	718	468	1,682	2,018
Total	7,000	3,905	2,338	8,400	10,079

Table 4-38

Polar Gas Pipeline

Craft Requirements
48 Hour Week

Craft	1984	1985	1986	1987	Total
Carpenters	99	212	219	133	663
Electricians	136	290	300	182	908
Insulators	72	153	158	96	479
Labourers	279	597	616	373	1,865
Millwrights	24	51	53	32	160
Operating Engineers	307	656	677	410	2,050
Pipefitter Welders/ Pipefitters	165	352	363	220	1,100
Teamsters	160	344	355	216	1,075
Others	15	32	33	20	100
Total	1,257	2,687	2,774	1,682	8,400

Table 4-39

Polar Gas Pipeline

Craft Requirements

40 Hour Week

Craft	1984	1985	1986	1987	Total
Carpenters	119	254	263	160	796
Electricians	163	348	360	218	1,089
Insulators	86	184	190	115	575
Labourers	335	716	739	448	2,238
Millwrights	29	61	64	38	192
Operating Engineers	368	787	812	492	2,459
Pipefitter Welders/ Pipefitters	198	422	436	264	1,320
Teamsters	192	413	426	259	1,290
Other	18	39	39	24	120
Total	1,508	3,224	3,329	2,018	10,079

Table 4-40

Large Construction Projects

Average Annual Manpower Requirements
48 Hour Week

Year	Petro-Chemical Plants	Coal and Steel	Tar Sands Extraction	Heavy Oil Extraction	Alcan Pipeline	Total
1979	-	-	129	-	-	129
1980	273	113	372	-	1,477	2,235
1981	768	186	1,602	744	1,473	4,773
1982	968	170	4,822	1,708	2,159	9,827
1983	596	234	10,403	3,588	2,159	16,980
1984	-	121	11,756	4,321	-	16,198
1985	-	-	7,133	2,073	656	9,862
1986	-	-	2,102	653	1,311	4,066
1987	-	-	-	-	656	656
Total	2,605	824	38,319	13,087	9,891	64,726

Table 4-41

Large Construction Projects

Average Annual Manpower Requirements
40 Hour Week

Year	Petro-Chemical Plants	Coal and Steel	Tar Sands Extraction	Heavy Oil Extraction	Alcan Pipeline	Total
1979	-	-	155	-	-	155
1980	328	136	446	-	1,772	2,682
1981	920	223	1,922	893	1,768	5,726
1982	1,162	204	5,787	2,050	2,591	11,794
1983	715	281	12,483	4,306	2,591	20,376
1984	-	145	14,107	5,185	-	19,437
1985	-	-	8,560	2,488	787	11,835
1986	-	-	2,522	784	1,573	4,879
1987	-	-	-	-	787	787
Total	3,125	989	45,982	15,706	11,869	77,671

consolidated tables due to uncertainty of project timing and route.

Examination of consolidated tables shows several significant factors:

1. Aggregate demand peaks run from 1981 through 1986.

2. Major contributors to demand peaks are Syncrude expansion project, Alsands tar sand project, Esso Resources heavy oil project and the Alcan natural gas pipeline.

3. Construction schedules for the two tar sands projects and Esso's Cold Lake heavy oil plant are coincident.

4. Demand peaks are shown for the following crafts; electricians, insulators, ironworkers, labourers, operating engineers, pipefitter welders/pipefitters and teamsters.

5. Introduction of a 40 hour work schedule rather than a 48 hour week will increase all requirements by 20 per cent.

Potential labour market reaction to these conditions will be discussed in the following chapter.

FOOTNOTES

1 Alberta Oil Sands Environmental Research Program (AOSERP), Long-Term Energy Assessment Program (Energy Supply Scenario: Oil Sands and Heavy Oil Development to 2025), 1975.

This program was jointly sponsored by the Governments of Canada and Alberta to increase the store of knowledge of baseline environmental data. Committees were set up to investigate and report on concerns relating to atmospheric, terrestrial, aquatic and wildlife matters. Scope of committee work expanded to include general observations and predictions.

2 Lawrence J. Murphy, "From Shortfall to Surplus in Oil and Gas," The Canadian Business Review, pp.43-46, Spring 1979.

3 Ibid.

4 Reported in "Big Tar Sands, Heavy Oil Supply Seen in Canada," The Oil and Gas Journal, p.19, December 18, 1978.

5 Alberta Department of Economic Development, List of Construction Projects as of January 1, 1979, p.51.

6 Ibid.

7 "GCOS Expansion Draws Near," Alberta Business, April 20, 1979.

8 Syncrude Canada Ltd., 1977 Long Term Plan, May 1979.

9 Ibid.

10 "Consortium Plans $4.9 Billion Oil Sands Plant," Oil Patch, p.3, January/February 1979.

11 "Cold Lake Proposal Looks Promising," Oil Patch, p.1, January/February 1979.

12 "Two Major Hurdles Face Oil Firms at Cold Lake," Edmonton Journal, p. D-14, September 5, 1978.

13 "Esso to Delay Cold Lake Oil Sands Plant," Edmonton Journal, p. D-6, February 9, 1979.

14 "Two Major Hurdles Face Oil Firms at Cold Lake," Edmonton Journal, p. D-14, September 5, 1978.

15 "Alaska Highway Pipeline Should Start Next Year," Business Life, pp.16-19, July 1979.

16 Ibid.

[17] "Polar Gas Files Pipeline Application," Oilweek, pp.32-33, January 9, 1978.

[18] "Polar Gas Eyes Western Pipeline Route," The Oil and Gas Journal, pp.42-43, January 15, 1979.

[19] Ibid.

Chapter V

SUMMARY AND CONCLUSIONS

Introduction

The thesis of this study is that timely exploitation of Alberta's oil sands and heavy oil deposits will be hampered by lack of construction manpower if simultaneous execution of several mega projects takes place. Specifically, concurrent construction of three major projects in the energy extraction sector will seriously unbalance the Alberta construction labour market. This situation would cause excessive labour market competition for available craftsmen leading to inefficient project execution specifically; schedule delays, "banking" of personnel and overall higher construction costs resulting in delays in bringing production to market.

This study has researched experience of the Syncrude project in this area in order to obtain criteria against which to assess potential labour market reaction to demands created by planned projects. The magnitude of total construction labour and individual craft demands generated by the projects considered has been forecast by the author in Chapter IV for the near term period 1979 through 1988. Comparison and analysis of data is the central topic of this chapter in order to achieve better understanding of actions of the Alberta con-

struction labour market and to indicate extent, if any, of construction labour shortages.

Syncrude Experience

Manpower planning for the Syncrude project was based on assumptions covering construction site conditions and the construction labour market as described in Chapter II. Construction site conditions assumptions were:

1. Remote location.
2. Decentralization of pre-assembly facilities in Edmonton.
3. Labour relations problems minimized by a "no strike - no lockout" site agreement.
4. Wage rates at union scale, equal or better than other projects.
5. Minimum overtime premium of 20 per cent assured by standard work week of 48 hours.
6. Recruitment practices to maximize Canadian labour content.

These assumptions held throughout the course of the project and provided a firm basis from which to carry out required recruitment activities.

Construction labour market assumptions are compared to actual experience in Table 5-1. It will be seen that the Syncrude managing contractor was essentially able to secure required tradesmen without undue effort, except for minor isolated cases. The lessening of construction activity in other parts of Canada was the key factor in maintaining the workforce at required levels.

Table 5-1

Syncrude Project

Construction Labour Market Planning Assumptions

Description	Plan	Actual
Economic environment	Strong, brisk climate, many projects planned	Weakened over course of the project
Manhours required	124,593	143,685
Manpower source		
- Alberta	67.0%	63.8%
- Rest of Canada	18.0%	35.4%
- International	15.0%	0.8%
Recruiting program	Active, routine outside contacts required past local level	Low key, spot shortages only required intensive effort
Labour shortfalls		
- Boilermakers	Minor	Minor
- Carpenters	Minor	Minor
- Pipefitter Welders/ Pipefitters	Minor	Minor
- Plasterers	Nil	Major
- Electricians	Major	Minor
- Insulators	Major	Major
- Ironworkers	Major	Minor
- Pipefitters	Major	Minor

Source: Canadian Bechtel Limited Manpower Recruiting Reports.

Analysis

As shown in Chapter IV, there is a substantial amount of construction activity planned in Alberta during the period covered by this study. Peak labour demand conditions are projected due to simultaneous construction of three major extraction projects and the Alcan natural gas pipeline. Due to their significant impact on the labour market the following analysis concentrates on these projects.

The analysis has been done in terms of site conditions and construction labour market factors. Site conditions factors are project conditions that are established by location, management, negotiation, or legislation during the planning stage and serve as fixed conditions throughout the life of a project. Construction labour market factors are essentially market reactions to demand occurring through the life of a project and resulting recruiting actions. Construction labour market factors are considered separately for the Edmonton and Northern Alberta areas.

Site Conditions Factors

Site conditions planning factors are deemed to be manageable by the project owner or contractor. These conditions are essentially good business practice and would likely be adopted in some form for any large project. Decentralization of pre-assembly facilities and overtime policy have an impact on the study and are discussed below.

Decentralized pre-assembly facilities. This approach

was used successfully by Syncrude. During the peak construction period approximately 10 per cent of the labour force was employed at Edmonton area pre-assembly sites. Manpower was obtained from the Edmonton area without undue pressure on local supplies. Esso Resources have already announced that their planning includes pre-assembly sites in or near Edmonton.[1] If the Alsands project also follows this plan, a work force in the order of 2,000 tradesmen will be required during the peak years 1983 and 1984. Ability of the local market to meet this demand will depend on the state of the economy at that time. Activity in the housing industry could be a critical factor.

Overtime policy. Establishment of the length of the normal work week is of major importance for successful completion of major projects in remote areas for two reasons. Firstly, number of regular and overtime hours worked during a normal week determines construction schedules, project progress and ultimate completion date. If 40 hours are worked per week instead of 48, the work force will have to be increased by 20 per cent in order to complete a project in the same time as one on a 48-hour schedule. The alternative is to use the same size crew and accept a 20 per cent extension of the completion schedule. The 40 hour week has other obvious disadvantages such as additional camp accommodation, larger supervisory staff, tie up of investment capital and lengthened execution schedule.

The second reason is more pertinent to labour market

activity. An important incentive used to encourage workers to leave home to work in remote areas is provision for substantial overtime premiums in job contracts.[2] Industry sources have indicated that it is extremely difficult to recruit craftsmen for projects outside their area of residence unless there is assurance of sufficient premium overtime.[3] It was felt that government regulations will depend on the competitive labour market situation, not necessarily the number of unemployed craftsmen, but indications as to whether or not workers will move to Northern Alberta for a 40 hour, straight time week.

Construction Labour Market Factors

Construction labour market factors are situations generated by the construction labour market's reaction to demand pressures. One of the key factors is the condition of the Canadian economy as it relates to the construction sector. The Syncrude project illustrates the dynamic nature of this factor. Manpower planning was based on a competitive labour market reflecting much construction activity in Alberta, central Canada and the Maritimes. However, by the time construction was underway, the weakening economy had caused significant cutbacks in construction programs. The ultimate effect on Syncrude was to improve the recruiting climate by making available more unemployed tradesmen from other regions of Canada than originally anticipated.

Currently the economy is very quiet with little new

construction planned other than the projects identified in this study. The present trend towards higher interest rates indicates that this could be a long-term situation. However, the concentration of projects planned for Alberta within the next ten years indicates that a strongly competitive labour market will exist in this province. The following sections discuss potential construction labour market conditions in the Edmonton and Northern Alberta regions.

Edmonton region. Large projects planned for the Edmonton area during the period studied are: Benzene and synthetic gas petrochemical plants; Esso Resources pre-assembly (announced); Alsands pre-assembly (probable); Foothills Alcan pipeline.

Schedules for the above projects are not completely coincident, but there are some significant overlaps. The last 18 months of the petrochemical projects overlaps the initial phase of the Esso and Alsands plants. Construction of the central and southern portions of the Alcan pipeline completely overlaps the other projects. Critical years are 1982 and 1983 when all projects are underway.

Assuming that 10 per cent of total manpower is required for pre-assembly facilities, the Edmonton area demand for 1982 and 1983 can be approximated as shown below. Requirements are based on the 48 hour scheduled work week so as to be comparable with the Syncrude project.

Average Staff	1982	1983
Petrochemical projects	1,000	600
Esso	200	400
Alsands	400	800
Total	1,600	1,800

Alcan pipeline demands for these years are 2,159 each year.

Requirements for the years 1984 and 1985, after completion of the petrochemical projects is estimated at:

Average Staff	1984	1985
Esso	400	200
Alsands	800	300
Total	1,200	500

Alcan pipeline demands for these years are nil.

These demands are considerably higher than Syncrude's average of 646, with a peak of 922, for the year 1976.

The Edmonton area labour market in 1976 was more competitive than that projected for the years 1982-1985. Syncrude had to compete with a housing boom, major Dow and Shamrock petrochemical projects at Fort Saskatchewan and the Alberta Gas Ethylene project at Joffre. However, Syncrude did have the advantage of a 48 hour scheduled work week, while some other projects were on a 40 hour schedule.

Outlook for the 1982-1985 period does not indicate any significant projects other than those shown. In addition, due to current trend towards high interest rates, prospects for commercial and housing starts are poor.

Craft mix needs may be partially integrated as the petrochemical projects will be slowing down when Esso and Alsands are building up. Civil type tradesmen such as carpenters, ironworkers, labourers, operating engineers and teamsters that are released first from the completing projects could migrate to the Esso and Alsands pre-assembly sites. Mechanical trades, not required in strength immediate-

ly, would follow when first projects are finished.

The Alcan pipeline will put some pressure on the Edmonton market for civil trades and pipefitter welders over the first two years. However, civil trades are less skilled and are generally more available. Also, it is anticipated that many of the pipeline jobs will be filled by tradesmen from outside the Edmonton area.

Assessment of the above factors leads to the conclusion that demand generated for tradesmen in the Edmonton area by the petrochemical, Esso, Alsands and Alcan projects can be met without distortion of the supply of tradesmen required by the fixed demand. An important consideration in this view is adoption of a scheduled 48 hour work week.

<u>Northern Alberta region</u>. Large projects planned for the Northern Alberta area during the period studied are: GCOS expansion; Syncrude debottleneck; Syncrude expansion; Alsands tar sands plant; Esso heavy oil plant; Foothills Alcan pipeline; Polar gas pipeline.

The GCOS expansion is the only major project underway during the first years of the study. Demand is nominal and well distributed over all crafts. However, this project is of interest for two reasons. Firstly, it is being executed on a scheduled 40 hour week. One wonders if this schedule will set the pattern for the much larger projects planned in coming years. Secondly, if permits are granted new projects for a scheduled 48 hour work week, will the GCOS contractor be able to withstand the competition and retain his staff?

Either course has potential for labour market problems. Industry experience has shown that if general conditions are equal workers will migrate to jobs in the area offering the highest scheduled overtime. This type of competition often "skims" the market of the best qualified tradesmen, leaving inferior quality workers for projects paying less hours.

As shown in Chapter IV, manpower demand starts to escalate rapidly in the years 1980-81 with starts at Syncrude and the Alcan pipeline. Project competition will be greatest in the years 1982-83 with GCOS, the two Syncrude projects, Alsands, Esso Resources and the northern sections of the Alcan pipeline all underway. Construction peaks for Syncrude, Alsands and Esso will coincide during 1983-84. The effect of simultaneous project construction will generate demands 3 to 4 times greater than the original Syncrude project in the years 1982-85. These projections are based on a scheduled 48 hour work week for all new projects. If job permits are not granted to extend legal hours of work demand will be increased in the order of 20 per cent. If the ratio of hires to average staff as determined for Syncrude applies to future market reactions the number of hires required to sustain efficient workforce levels will be exceptionally high, as shown in Tables 5-2 and 5-3. Demand of this scale indicates that substantial supply support will be required from sources outside of Alberta. At the Syncrude Mildred Lake site, number of Alberta hires ranged from 4,907 to 6,343, with a project

Table 5-2

Syncrude Project

Mildred Lake Site

Ratio of Hires to Average Staff

Year	Hires	Staff	Ratio
1975	6,311	2,320	2.7
1976	8,268	4,525	1.8
1977	11,326	5,619	2.0
1978	5,661	1,830	3.1

Source: Canadian Bechtel Limited Recruiting and Project Statistics.

Table 5-3

Northern Alberta Projects

Projected Hires to Maintain Stable Workforce

Equivalent Project Years	Demand*	Hires/Staff Ratio	Projected Total Hires
1975/82	7,089	2.7	19,140
1976/83	14,350	1.8	25,830
1977/84	14,877	2.0	29,754
1978/85	9,362	3.1	29,022

* Total Northern Alberta demand less estimated Edmonton area preassembly facilities.

Derived from Tables 4-40 and 5-2.

average of 5,037 equivalent to 63.8 per cent of total hires. As shown in Chapter III, the actual proportion of Alberta tradesmen was considerably below that planned. These statistics imply that the number of Alberta tradesmen that can be attracted to a project such as Syncrude is limited, possibly 6,500 to 7,000 under present conditions. Given restricted local supply other Canadian provinces are the next logical areas of support.

Canadian sources, other than Alberta, supplied over 35 per cent of hires for the Mildred Lake site. Review of recruiting statistics contained in Chapter III shows differing trends for each of the provincial areas. British Columbia, Yukon and the Northwest Territories reached a peak in 1976 of 13.0 per cent then dropped to 5.2 per cent in 1978. Manitoba-Saskatchewan participation remained constant in the order of 2.6 per cent. Ontario's trend was similar to British Columbia, peaking to 9.7 per cent in 1977 and then dropping off to 4.2 per cent in 1978. Quebec and the Maritimes increased their relative participation each year until reaching a peak in 1977, decrease in 1978 was not as large as the other provinces. These trends reflect the downturn in the economy in the late 1970's which reduced the demand for construction labour thus accelerating migration to Alberta. Supply from international sources was not significant, being less than one per cent and limited to spot situations. Actual supply was much less than the initial plan due to increased manpower availability from eastern Canada.

Continuing weak economic conditions in the rest of Canada will help manpower recruiting for Alberta projects. However, labour supplies in British Columbia, Saskatchewan and Manitoba are limited by small populations of construction workers. Ontario, Quebec and the Maritimes offer the best source of workers. The competitive aspects of manning the equivalent of four Syncrude projects are formidable. If the market reacts in a fashion similar to Syncrude, 20,000 to 30,000 workers will have to be hired in each of the four peak years. This sounds like an unrealistic objective but it could likely be met if certain conditions were carried out, for example:

1. Much greater recruiting effort.
2. Projects should be allowed to run on a 48 hour week to scale down overall demand.
3. Incentives, such as guaranteed minimum premium overtime, to encourage migration.

Failure to recruit required tradesmen in other parts of Canada will result in recruitment of tradesmen from the United States and abroad. Possible recession in the United States may have a beneficial effect on the supply of experienced tradesmen available.

The complexity of this issue is illustrated by conflicting comments of two senior industry executives. In January of this year, R. B. Peterson, Vice-President of Heavy Oils of Esso Resources Canada, Ltd., stated that "slack in the construction industry in Canada makes this a good time to undertake a major project." Mr. Peterson also indicated

that he did not expect any critical labour shortages if Esso and Alsands constructed their plants at the same time.[4]

More recently, Brent Scott, President of Syncrude advocated building oil sands plants on a three-year timetable. Mr. Scott stated that "staged construction of new plants would mean much of the technical and skilled trades force could move in sequence from one new plant site to the next." Mr. Scott was also concerned that simultaneous construction of two multi-billion dollar oil sands plants would compound labour and supply problems and probably delay completion of the plants.[5] Mr. Scott did not mention that planned construction projects in his plant will be strong competitors in the labour market at the same time.

Consideration of the above factors shows an extremely competitive labour demand-supply situation. Probability of meeting total demand if all projects proceed as scheduled is very low. Demand can be met only if project workforce turnover rates are reduced and massive labour migration from eastern Canada takes place.

Conclusions

Purpose of this study has been to improve current understanding of the Alberta construction labour market and to investigate the ability of this market to react to the demands for construction workers generated by simultaneous construction of several large projects. Detailed analysis of the Syncrude project involving both forecast and actual actions of the construction labour market has been applied

to the projected condition of simultaneous construction of several mega projects. Results indicate that the Edmonton area could likely support the required pre-assembly operations. However, coincident demands in Northern Alberta are so great that it is extremely doubtful if projects can proceed efficiently as scheduled.

The foregoing text has shown that continued delays and postponements in the major projects, particularly the Alaska Highway pipeline and the Alsands and Esso Resources ventures, have created a potential for a concentrated level of construction activity several times greater than the Syncrude project during the years 1982-1985. The competitive market induced by this situation will create a condition of excess demand as illustrated in Figure 1-2. Supply market reactions to this demand pressure are anticipated to be extreme and could take several forms as outlined below.

Uncontrolled case. The mega projects will attempt to attract local tradesmen by offering long-term contracts at premium wages and hours. This strategy would seriously hamper smaller projects, shown in Table 4-2, completing or starting during the critical years 1982 through 1985 if their terms of employment could not match the long-term employment conditions offered by the larger projects. Types of jobs that would lose workers are operating plants such as Syncrude, GCOS and oil refineries that rely on contract labour forces to do routine maintenance on an "as required" basis and smaller capital construction jobs, for example, coal treatment plants,

GCOS expansion and the Syncrude debottleneck and expansion projects. Shortages of construction workers could lead to extended maintenance shutdowns in operating plants and could prolong completions or delay starts in the case of new construction work, in either case the ultimate effect would be loss of production.

The above market conditions will force recruitment of tradesmen from outside Alberta for all construction and maintenance jobs, large or small. In order to attract workers and reduce turnover improvements will have to be made to hiring conditions. Typical inducements could be hiring bonuses, reimbursement of travel costs if workers stay on the job for a minimum period or work contracts for the life of the project with travel costs paid for home furloughs. Essentially, Northern Alberta could be treated as a foreign country for recruiting purposes insofar as travel and home leave conditions of employment are concerned. Projects would also be forced to compete in terms of camp amenities and the amount of guaranteed premium overtime.

Managed case. The character of the construction labour market outlined above could lead to the condition of structural unemployment and loss of productivity referred to by the Kaliski article cited in Chapter I.[6] Unfortunately there does not appear to be a central body concerned with the subject situation that can apply Kaliski's theory. It could well be, however, that the industry could take steps to provide for a more orderly market condition, not so much to

relieve structural unemployment but to expedite production. Management of the demand side of the market is a possibility given that the large cost of mega projects requires spreading the financial load among many owners. The result is a series of consortiums and joint ventures with large firms often being members of several groups. Influential interests could promote construction priorities so that large projects would be coordinated rather than competitive.

Regardless of project priorities industry and labour associations, either individually or jointly, would become involved with other aspects of the labour market. Expansion of the supply of trained local tradesmen would be a major concern. Traditional actions are promotion of trade school, apprentice and on-the-job training. Modification of apprenticeship regulations to allow more interested workers to become skilled tradesmen could be considered. The various levels of government could be asked to sponsor more specialized construction training particularly in the mechanical trades.

Steps could be taken to increase productivity on the job. A recent study indicates that only 32 per cent of a construction worker's time is devoted to direct work while the balance is spent on such non-work activities as waiting, getting instruction, late starts and early quits.[7] The potential shortage of skilled labour should be taken as a warning by contractors and owners to improve the planning, coordination and supervision skills of their project management organizations. In terms of the 16,980 workers estimated to be

required in the year 1983, a ten per cent improvement in productivity through better project management techniques would ease demand by 1,698 men.[8]

Controlled case. The types of labour market actions described above are essentially unilateral. The present state of the Canadian economy requires decisive, coordinated action in order to improve production and distribution of indigeneous petroleum supplies, action that can only be undertaken by federal and provincial government authorities working together. This study suggests several opportunities for effective government intervention:

1. Recruitment - The recruiters working for the Syncrude project relied on union business agents to relay information on job vacancies to the labour market. It is unlikely that such a system would be able to satisfy the large manpower requirements in the coming years. A further consideration is the need to restrict the flow of workers into remote areas so as not to overtax limited accommodation facilities. These concerns could be minimized if all job information and pre-employment screening was carried out by Canada Manpower Centres, as was done for the St. Lawrence Seaway project.[9] Organization on this basis would enable a constant flow of supply market data to be passed on to project recruiters through the Edmonton Manpower Centre. Provision of full and up-to-date information on specific job vacancies in the Manpower Centres would strengthen the labour process, a need implied by the Bruce and Marshall study referred to in Chapter

I as well as other writers on the subject.[10]

2. Mobility - Government assistance in attracting and recruiting workers from other parts of Canada could be extended through a system of mobility assistance. R. R. Kerton outlines several types of available grants in Active Manpower Programs in Canada, but none appear to cover the specific requirements of this situation.[11] A system that would assist recruiting and reduce turnover would tie the amount of fare reimbursement to length of service on the job; for example, 50 per cent of fare could be refunded after six months with a 100 per cent refund after one year's service. A variation of this policy could be government sponsored air-lifts on a regular schedule using chartered commercial or service aircraft.

3. Training - The projects considered in this study are likely the forerunners of a series of tar sand and heavy oil extraction plants which will generate a continuing demand for well trained heavy construction workers. This situation calls for a training institution specializing in heavy construction crafts. Establishment of such a school would be an important step towards creation of a "tar sands" workforce that would migrate from one project to another. Courses could be structured on an alternating instruction-work term basis so that students could follow an approved apprenticeship program. Free tuition could be granted in return for an undertaking by students to work for a stipulated period on a tar sands project.

4. Staged construction - The ultimate in government control is regulation of the schedule for construction of mega energy resource extraction projects. This step could be taken to link national objectives for energy self-sufficiency to the actual physical developments. Adoption of this plan would stagger project starts at intervals of every two - three years. In theory, this procedure would allow construction crews to migrate from one job to another as successive construction phases were completed.

Recommendations

The objective of this study has been to contribute to the store of knowledge in the heavy construction industry by improving current understanding of the Alberta construction labour market under conditions of excessive demand. Its major contributions lie in the fact that it is the first study of this nature prepared within the industry and that the data and recommendations can be of significant assistance in planning construction projects in the near term period.

It would be purposeless to speculate as to which of the conclusions described above, if any, will actually appear in the labour market. It is of more value to identify actions that could be taken as practical efforts to alleviate potential supply shortages.

Productivity. Improvement in output presents a simple, yet challenging method of reducing pressure on the supply market. Productivity studies and analyses implemented under

joint sponsorship of owners, contractors and unions should be carried out during the planning and initial construction stages of lengthy jobs. Results should allow management to strengthen planning and supervision procedures as required to improve worker output.

Training. The potential shortage of skilled tradesmen should be recognized by establishment of a trade school specializing in building trades. Such an institution would provide a new source of well-trained entries into the labour force which would ultimately benefit all regions of Canada. Changes would have to be made to apprenticeship regulations, in conjunction with the trade school, so that graduates could achieve journeyman status.

Recruiting. Present recruiting practices are inefficient in that often contractors do not know what the response will be to calls put out through the union hiring halls. This can result in shortages with consequent job delays or in surplusses with tradesmen doing unnecessary travelling. Use of Canada Manpower Centres to coordinate recruitment could provide a source of better labour supply information, thus allowing contingency plans to be activated in case of supply shortfalls. Only qualified tradesmen, acceptable for specific job vacancies, would be advised to travel to the job site. Provision of a government sponsored system of travel allowances also appears to be necessary as an inducement for workers to leave home.

Hours of work. As previously stated, a minimum work

week of 48 hours is necessary. Use of a 48 hour week rather than 40 hours automatically reduces overall man months by 20 per cent as well as providing a strong monetary incentive for workers to come on the project.

Labour market trends. Lack of knowledge of probable labour market trends appears to be one of the major problems facing the Alberta construction industry. There is no one agency that has the responsibility to gather all relevant factors and project construction labour market trends. It would be logical for the Alberta construction industry to take the lead in jointly establishing such an agency in conjunction with the federal and provincial governments. A task force could be funded in one of the existing government departments or in one of the universities for a fraction of the cost of possible project delays due to shortfalls in the labour market. The various theories and surveys mentioned in this study would provide an excellent background for development of an Alberta labour market model.

Construction staging. The majority of the recommendations listed above require a relatively long lead time for implementation and therefore may not be effective in moderating market shortages in the near term. One method that can be adopted on short notice is the principle of staged construction of mega projects. This plan proposes elimination of peak labour demands by regulating project starts to one every two or three years. In theory, staggering of sequential construction phases would allow creation of a

permanent work force that could migrate from one job to another as work progressed. It is timely to note that government measures to prevent bunching of construction projects was recently suggested as one of several ways to stabilize the construction market in Quebec.[12] The process necessary to phase in project starts already exists in the Alberta Energy Resources Conservation Board. Issuance of permits could be governed by economic conditions and state of the labour force. While some persons may object to more government intervention in the marketplace, this system is the most logical approach to Canadian energy self-sufficiency.

It is fitting to conclude with a statement by the late Mr. F. K. Spragins on the subject of government participation:

> . . . there is an indicated trend which suggests that many future natural resource development projects may be too large for any one group to handle necessitating an increasing degree of cooperation between free enterprise and government.[13]

FOOTNOTES

1 "Cold Lake Proposal Looks Promising," <u>Oil Patch</u>, January/February, 1979.

2 This method was used to attract workers to the Syncrude project and to the St. Lawrence Seaway project. It is described by Donald E. Cullen in "Labour-Market Aspects of the St. Lawrence Seaway Project," <u>The Journal of Political Economy</u>, University of Chicago Press, June, 1960.

3 Interviews with Mr. J. A. Cunningham, Manager of Labour Relations, Canadian Bechtel Limited, Mr. B. Smyth, Industrial Relations Manager, Syncrude Canada Ltd. and Mr. T. D. P. Byers, Project Manager, Genstar Ltd.

4 Testimony before Energy Resources Conservation Board, reported in the <u>Edmonton Journal</u>, January 15, 1979. "Building slack makes oil plant 'timely'."

5 Address to Canadian-United States inter-parliamentary group visiting Syncrude, reported in <u>Alberta Business</u>, August 24, 1979. "Syncrude chief urges three years between plants."

6 S. F. Kaliski, "Structural Unemployment in Canada: The Occupational Dimension," <u>The Canadian Journal of Economics</u>, Vol.2, No.2, May 1969. University of Toronto Press.

7 M. Strandell, "Pushing Up Productivity," <u>Cockshaw's Construction Labour News + Opinion</u>, Vol.7, No.9, September 1977.

8 Reference Table 4-40. Page 122.

9 Donald E. Cullen, "Labour-Market Aspects of the St. Lawrence Seaway Project," <u>The Journal of Political Economy</u>, June 1960. University of Chicago Press.

10 Economic Council of Canada. <u>People and Jobs. A Study of the Canadian Labour Market</u>, Ottawa: Information Canada, 1977, pp.130-133.

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11 Kerton, <u>op. cit.</u>, Chapter VI.

12 Raymond Depatie, "La stabilisation de la construction au Quebec," Relations Industrielles, Vol.33, No.3, 1978. Les Presses de l'Universite Laval.

13 F. K. Spragins, "Government Involvement in the Syncrude Project," speech to the Propane Gas Association, Edmonton, May 29, 1975.

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APPENDIX A

Syncrude Project: Planned Manpower Requirements
Mildred Lake Site

APPENDIX A

Syncrude Project: Planned Manpower Requirements
Mildred Lake Site*

Table | Page

* Source: Canadian Bechtel Limited, _Manpower Recruiting Report_, November 1975.

Table 1

Syncrude Project: Construction Manpower Requirements
Mildred Lake Site

1975

	Oct.	Nov.	Dec.
Boilermakers	269	319	286
Carpenters	324	258	251
Cement Finishers	28	23	15
Electricians	304	368	250
Insulators	-	-	-
Ironworkers	371	403	300
Labourers	800	622	281
Millwrights	9	13	22
Operating Engineers	886	718	486
Pipefitters	331	319	327
Pipefitter Welders	125	118	125
Sheet Metal Workers	49	35	26
Teamsters	274	227	227

Table 2

Syncrude Project: Construction Manpower Requirements

Mildred Lake Site

1976

	J	F	M	A	M	J	J	A	S	O	N	D
Boilermakers	300	231	237	261	262	278	279	250	261	245	203	170
Carpenters	301	302	333	411	464	423	423	362	330	320	239	222
Cement Finishers	17	14	17	35	61	71	67	54	49	47	33	30
Electricians	340	368	422	493	547	560	574	576	615	640	695	686
Insulators	-	-	-	34	112	125	150	147	153	149	123	112
Ironworkers	286	274	343	411	409	385	395	405	389	422	417	405
Labourers	445	563	648	762	830	834	842	810	765	664	647	556
Millwrights	49	54	69	86	93	111	106	118	122	138	137	123
Operating Engineers	505	523	550	591	722	888	928	901	806	703	590	489
Pipefitters	412	513	543	569	715	820	958	1,116	1,119	1,169	1,123	1,021
Pipefitter Welders	161	200	211	221	278	320	371	435	435	450	440	400
Sheet Metal Workers	8	13	20	26	31	38	45	59	71	72	68	38
Teamsters	172	177	192	186	224	245	245	234	235	229	198	169

Table 3

Syncrude Project: Construction Manpower Requirements

Mildred Lake Site

1977

	J	F	M	A	M	J	J	A	S	O	N	D
Boilermakers	151	142	124	101	100	99	117	107	93	80	75	54
Carpenters	219	216	218	229	240	232	220	216	186	177	167	166
Cement Finishers	19	20	19	18	20	20	20	19	17	19	21	20
Electricians	717	735	729	721	730	693	695	689	673	660	546	506
Insulators	153	207	253	338	461	432	450	508	476	506	483	355
Ironworkers	403	448	354	349	352	353	346	322	284	262	248	247
Labourers	467	448	432	485	501	500	476	471	455	452	382	379
Millwrights	117	117	106	107	92	97	84	85	82	81	61	91
Operating Engineers	498	498	502	504	534	543	533	564	535	509	482	443
Pipefitters	1,020	988	1,090	1,169	1,323	1,340	1,311	1,366	1,194	1,055	949	562
Pipefitter Welders	320	310	345	370	420	420	410	430	375	330	300	175
Sheet Metal Workers	20	15	15	15	10	10	10	10	7	7	7	7
Teamsters	174	168	167	170	175	175	175	174	170	157	178	185

Table 4

Syncrude Project: Construction Manpower Requirements
Mildred Lake Site

1978

	J	F	M	A	M	J	J	A	S	O	N	D
Boilermakers	68	46	39	28	17	18	19	13	12	12	12	5
Carpenters	171	162	161	134	104	89	83	48	36	30	17	8
Cement Finishers	19	19	19	8	8	4	--	--	--	--	--	--
Electricians	405	352	297	287	257	127	126	58	48	22	17	5
Insulators	301	194	140	130	100	100	100	80	50	--	--	--
Ironworkers	228	185	138	133	67	56	43	27	24	23	6	3
Labourers	372	329	279	239	191	187	179	166	156	105	62	29
Millwrights	67	46	29	28	24	15	15	9	12	--	--	--
Operating Engineers	458	458	461	460	413	399	336	195	211	210	106	44
Pipefitters	681	650	543	386	303	235	193	57	70	59	31	12
Pipefitter Welders	180	170	145	100	80	60	50	15	18	15	8	3
Sheet Metal Workers	7	7	7	7	5	3	2	1	1	--	--	--
Teamsters	166	166	147	137	114	114	78	49	48	52	17	5

Table 5

Syncrude Project

Boilermaker Manpower Sources

	Total Required Force	Anticipated Local Supply	Anticipated Supply in Canada
Oct. 1975	269	250	19
Nov.	319	290	29
Dec.	286	286	--
Jan. 1976	300	290	10
Feb.	231	231	--
Mar.	237	237	--
Apr.	261	220	40
May	262	200	62
June	278	200	78
July	279	200	79
Aug.	250	200	50
Sept.	261	240	21
Oct.	245	245	--
Nov.	203	203	--
Dec.	170	170	--
Jan. 1977	Adequate local supply is anticipated in 1977 and 1978		

Table 6

Syncrude Project

Carpenter Manpower Sources

	Total Required Force	Anticipated Local Supply	Anticipated Supply in Canada
Oct. 1975	324	324	---
Nov.	258	258	---
Dec.	251	251	---
Jan. 1976	301	301	---
Feb.	302	302	---
Mar.	333	333	---
Apr.	411	320	91
May	464	300	164
June	423	320	103
July	423	320	103
Aug.	362	320	42
Sept.	330	320	10
Oct.	320	320	---
Nov.	239	239	---
Dec.	222	222	---
Jan. 1977	Adequate local supply is anticipated in 1977 and 1978		

Table 7

Syncrude Project

Electrician Manpower Sources

	Total Required Force	Anticipated Local Supply	Anticipated Supply in Canada
Oct. 1975	304	150	154
Nov.	368	200	168
Dec.	250	250	--
Jan. 1976	340	340	--
Feb.	368	368	--
Mar.	422	422	--
April	493	450	43
May	547	400	147
June	560	350	210
July	574	350	224
Aug.	576	350	226
Sept.	615	350	265
Oct.	640	400	240
Nov.	695	450	245
Dec.	686	450	236
Jan. 1977	717	500	217
Feb.	735	500	235
Mar.	729	500	229
April	721	450	271
May	730	450	280
June	693	450	243
July	695	450	245
Aug.	689	450	239
Sept.	673	450	223
Oct.	660	500	160
Nov.	546	500	46
Dec.	506	500	6
Jan. 1978	Adequate local supply is anticipated in 1978		

Table 8

Syncrude Project

Insulator Manpower Sources

	Total Required Force	Anticipated Local Supply	Anticipated Supply in Canada
Oct. 1975	Adequate local supply is anticipated in 1975 and 1976		
Jan. 1977	153	153	--
Feb.	207	207	--
Mar.	253	253	--
April	338	240	98
May	461	220	241
June	432	240	192
July	450	300	150
Aug.	508	330	178
Sept.	476	350	126
Oct.	506	340	166
Nov.	483	350	133
Dec.	355	355	--
Jan. 1978	Adequate local supply is anticipated in 1978		

Table 9

Syncrude Project

Ironworker Manpower Sources

	Total Required Force	Anticipated Local Supply	Anticipated Supply in Canada	Recruit Outside Canada
Oct. 1975	371	210	120	41
Nov.	403	240	120	43
Dec.	300	240	60	--
Jan. 1976	286	240	46	--
Feb.	274	240	34	--
Mar.	343	220	80	43
April	411	200	60	151
May	409	200	50	159
June	385	200	50	135
July	395	200	50	145
Aug.	405	180	50	175
Sept.	389	180	50	159
Oct.	422	180	50	192
Nov.	417	200	70	147
Dec.	405	220	80	105
Jan. 1977	403	220	80	103
Feb.	448	220	80	148
Mar.	354	220	80	54
April	349	200	60	89
May	352	200	50	102
June	353	200	50	103
July	346	200	50	96
Aug.	322	200	50	72
Sept.	284	200	50	34
Oct.	262	200	50	12
Nov.	248	220	28	--
Dec.	247	240	7	--
Jan. 1978	Adequate local supply is anticipated in 1978			

Table 10

Syncrude Project

Pipefitter Manpower Sources

	Total Required Force	Anticipated Local Supply	Anticipated Supply in Canada	Recruit Outside Canada
Oct. 1975	331	100	231	--
Nov.	319	190	129	--
Dec.	327	300	27	--
Jan. 1976	412	412	--	--
Feb.	513	450	63	--
Mar.	543	450	93	--
April	569	415	154	--
May	715	375	340	--
June	820	300	400	120
July	958	220	380	358
Aug.	1,116	160	360	596
Sept.	1,119	150	350	619
Oct.	1,169	140	340	689
Nov.	1,123	100	340	683
Dec.	1,021	140	360	521
Jan. 1977	1,020	220	460	340
Feb.	988	235	480	273
Mar.	1,090	250	455	385
April	1,169	200	430	539
May	1,323	140	390	793
June	1,340	130	400	810
July	1,311	130	410	771
Aug.	1,366	170	400	796
Sept.	1,194	220	455	519
Oct.	1,055	270	500	285
Nov.	949	260	540	149
Dec.	562	325	237	--
Jan. 1978	681	370	311	--
Feb.	650	380	270	--
Mar.	543	405	138	--
April	386	350	36	--
May	303	270	33	--
June	235	235	--	--

Adequate local supply is anticipated for the balance of 1978

Table 11

Syncrude Project

Pipefitter Welder Manpower Sources

	Total Required Force	Anticipated Local Supply	Anticipated Supply in Canada	Recruit Outside Canada
Oct. 1975	125	50	75	--
Nov.	118	60	58	--
Dec.	125	100	25	--
Jan. 1976	161	150	11	--
Feb.	200	150	50	--
Mar.	211	150	61	--
April	221	135	86	--
May	278	125	153	--
June	320	120	200	--
July	371	130	220	21
Aug.	435	140	240	55
Sept.	435	150	250	35
Oct.	450	160	260	30
Nov.	440	160	260	20
Dec.	400	160	240	--
Jan. 1977	320	180	140	--
Feb.	310	190	120	--
Mar.	345	200	145	--
April	370	200	170	--
May	420	210	210	--
June	420	220	200	--
July	410	220	190	--
Aug.	430	230	200	--
Sept.	375	230	145	--
Oct.	330	230	100	--
Nov.	300	240	60	--
Dec.	175	175	--	--
Jan. 1978	Adequate local supply is anticipated in 1978			

APPENDIX B

Syncrude Project: Actual Manpower Requirements

APPENDIX B

Syncrude Project: Actual Manpower Requirements*

* Source: Canadian Bechtel Limited. Syncrude Project Monthly Status Reports.

Table 1

Syncrude Project

Construction Manpower Requirements - All Crafts
Mildred Lake Site

Conversion of Established Residence Statistics to Manmonths
Years 1976 - 1978

New Hires by Established Residence		Percent	Project Manmonths
Alberta	15,239	60.3	86,642
National	9,780	38.7	55,606
International	236	1.0	1,437
Total	25,255	100.0	143,685

Table 2

Syncrude Project

Construction Manpower Requirements - All Crafts
1974 and 1975

Manmonths	Mildred Lake Site	Edmonton Sites	Total
1974			
January	166	-	166
February	374	-	374
March	469	-	469
April	394	-	394
May	580	3	583
June	765	4	769
July	907	4	911
August	1,023	6	1,029
September	1,083	4	1,087
October	1,190	12	1,202
November	1,256	19	1,275
December	1,273	23	1,296
	9,480	75	9,555
1975			
January	625	4	629
February	856	12	868
March	1,262	14	1,276
April	1,663	26	1,689
May	1,934	90	2,024
June	2,466	122	2,588
July	2,853	171	3,024
August	3,110	142	3,252
September	3,488	261	3,749
October	3,477	433	3,910
November	3,340	418	3,758
December	2,762	377	3,139
	27,836	2,070	29,906

Table 3

Syncrude Project

Construction Manpower Requirements - All Crafts
1976 and 1977

Manmonths	Mildred Lake Site	Edmonton Sites	Total
1976			
January	2,914	364	3,278
February	2,903	350	3,253
March	3,055	371	3,426
April	3,455	585	4,040
May	4,253	525	4,778
June	4,848	776	5,624
July	5,380	922	6,302
August	5,664	903	6,567
September	5,777	878	6,655
October	5,382	758	6,140
November	5,465	690	6,155
December	5,203	629	5,832
	54,299	7,751	62,050
1977			
January	5,159	606	5,765
February	5,748	649	6,397
March	6,050	546	6,596
April	6,117	461	6,578
May	6,122	392	6,514
June	6,255	264	6,519
July	6,380	116	6,496
August	6,206	64	6,270
September	5,678	34	5,712
October	4,997	20	5,017
November	4,642	18	4,660
December	4,069	18	4,087
	67,423	3,188	70,611

Table 4

Syncrude Project

Construction Manpower Requirements - All Crafts

1978

Manmonths	Mildred Lake Site	Edmonton Sites	Total
1978			
January	3,265	16	3,281
February	3,469	16	3,485
March	2,813	16	2,829
April	2,380	15	2,395
May	1,754	10	1,764
June	1,160	10	1,170
July	992	8	1,000
August	1,253	8	1,261
September	1,430	8	1,458
October	1,368	8	1,376
November	1,178	-	1,178
December	881	-	881
	21,963	115	22,078

APPENDIX C

Large Construction Projects
Craft Requirements

APPENDIX C

Large Construction Projects
Craft Requirements*

* Source: Summarized from individual project projections contained in Chapter IV.

Table 1

Large Construction Projects

1979 Craft Requirements

48 Hour Week

Craft	Petrochemical Plants	Coal and Steel	Tar Sands Extractions	Heavy Oil Extractions	Alcan Gas Pipelines	Total
Boilermakers	-	-	5	-	-	5
Carpenters	-	-	9	-	-	9
Electricians	-	-	17	-	-	17
Insulators	-	-	7	-	-	7
Ironworkers	-	-	9	-	-	9
Labourers	-	-	18	-	-	18
Millwrights	-	-	2	-	-	2
Operating Engineers	-	-	23	-	-	23
Pipefitter Welders - Pipefitters	-	-	26	-	-	26
Sheet Metal Workers	-	-	2	-	-	2
Teamsters	-	-	8	-	-	8
Others	-	-	3	-	-	3
Total	-	-	129	-	-	129

Table 2

Large Construction Projects

1979 Craft Requirements

40 Hour Week

Craft	Petrochemical Plants	Coal and Steel	Tar Sands Extractions	Heavy Oil Extractions	Alcan Gas Pipelines	Total
Boilermakers	-	-	6	-	-	6
Carpenters	-	-	11	-	-	11
Electricians	-	-	20	-	-	20
Insulators	-	-	8	-	-	8
Ironworkers	-	-	11	-	-	11
Labourers	-	-	22	-	-	22
Millwrights	-	-	2	-	-	2
Operating Engineers	-	-	28	-	-	28
Pipefitter Welders - Pipefitters	-	-	31	-	-	31
Sheet Metal Workers	-	-	2	-	-	2
Teamsters	-	-	10	-	-	10
Others	-	-	4	-	-	4
Total	-	-	155	-	-	155

Table 3

Large Construction Projects

1980 Craft Requirements

48 Hour Week

Craft	Petrochemical Plants	Coal and Steel	Tar Sands Extractions	Heavy Oil Extractions	Alcan Gas Pipelines	Total
Boilermakers	11	17	15	-	-	43
Carpenters	19	3	26	-	117	165
Electricians	36	3	49	-	160	248
Insulators	15	-	20	-	84	119
Ironworkers	19	38	26	-	-	83
Labourers	38	8	53	-	328	427
Millwrights	4	12	6	-	28	50
Operating Engineers	49	10	66	-	360	485
Pipefitter Welders - Pipefitters	55	17	74	-	193	339
Sheet Metal Workers	4	-	5	-	-	9
Teamsters	16	4	22	-	189	231
Others	7	1	10	-	18	36
Total	273	113	372	-	1,477	2,235

Table 4

Large Construction Projects

1980 Craft Requirements

40 Hour Week

Craft	Petrochemical Plants	Coal and Steel	Tar Sands Extractions	Heavy Oil Extractions	Alcan Gas Pipelines	Total
Boilermakers	13	20	18	-	-	51
Carpenters	23	4	31	-	140	198
Electricians	43	4	59	-	192	298
Insulators	18	-	24	-	100	142
Ironworkers	23	46	31	-	-	100
Labourers	46	10	64	-	394	514
Millwrights	5	14	7	-	34	60
Operating Engineers	59	12	79	-	432	582
Pipefitter Welders - Pipefitters	66	20	89	-	232	407
Sheet Metal Workers	5	-	6	-	-	11
Teamsters	19	5	26	-	227	277
Others	8	1	12	-	21	42
Total	328	136	446	-	1,772	2,682

Table 5

Large Construction Projects

1981 Craft Requirements

48 Hour Week

Craft	Petrochemical Plants	Coal and Steel	Tar Sands Extractions	Heavy Oil Extractions	Alcan Gas Pipelines	Total
Boilermakers	31	27	49	18	-	125
Carpenters	55	5	143	77	117	397
Electricians	101	5	138	38	160	442
Insulators	40	-	37	-	84	161
Ironworkers	55	64	98	40	-	257
Labourers	107	13	285	155	328	888
Millwrights	12	19	12	-	28	71
Operating Engineers	137	17	492	301	360	1,307
Pipefitter Welders - Pipefitters	154	28	172	28	193	575
Sheet Metal Workers	10	-	9	-	-	19
Teamsters	46	7	111	57	189	410
Others	20	1	56	30	14	121
Total	768	186	1,602	744	1,473	4,773

Table 6

Large Construction Projects

1981 Craft Requirements

40 Hour Week

Craft	Petrochemical Plants	Coal and Steel	Tar Sands Extractions	Heavy Oil Extractions	Alcan Gas Pipelines	Total
Boilermakers	37	32	58	22	-	149
Carpenters	66	6	172	92	140	476
Electricians	121	6	165	46	192	530
Insulators	48	-	44	-	100	192
Ironworkers	66	77	118	48	-	309
Labourers	128	16	342	186	394	1,066
Millwrights	14	23	14	-	34	85
Operating Engineers	164	20	590	361	432	1,567
Pipefitter Welders - Pipefitters	185	34	206	34	232	691
Sheet Metal Workers	12	-	12	-	-	24
Teamsters	55	8	133	68	227	491
Others	24	1	68	36	17	146
Total	920	223	1,922	893	1,768	5,726

Table 7

Large Construction Projects

1982 Craft Requirements

48 Hour Week

Craft	Petrochemical Plants	Coal and Steel	Tar Sands Extractions	Heavy Oil Extractions	Alcan Gas Pipelines	Total
Boilermakers	39	25	220	85	-	369
Carpenters	68	4	482	176	171	901
Electricians	128	4	340	113	233	818
Insulators	52	-	25	-	123	200
Ironworkers	69	58	372	140	-	639
Labourers	135	12	1,012	374	479	2,012
Millwrights	15	18	12	3	41	89
Operating Engineers	172	16	1,329	454	527	2,498
Pipefitter Welders - Pipefitters	194	26	426	142	283	1,071
Sheet Metal Workers	13	-	10	3	-	26
Teamsters	58	6	351	126	276	817
Others	25	1	243	92	26	387
Total	968	170	4,822	1,708	2,159	9,827

Table 8

Large Construction Projects

1982 Craft Requirements

40 Hour Week

Craft	Petrochemical Plants	Coal and Steel	Tar Sands Extractions	Heavy Oil Extractions	Alcan Gas Pipelines	Total
Boilermakers	47	30	264	102	-	443
Carpenters	82	5	579	211	205	1,082
Electricians	154	5	408	136	280	983
Insulators	62	-	30	-	148	240
Ironworkers	83	70	445	168	-	766
Labourers	162	14	1,214	449	575	2,414
Millwrights	18	22	15	4	49	108
Operating Engineers	205	19	1,596	545	632	2,997
Pipefitter Welders - Pipefitters	233	31	511	170	340	1,285
Sheet Metal Workers	16	-	12	4	-	32
Teamsters	70	7	422	151	331	981
Others	30	1	291	110	31	463
Total	1,162	204	5,787	2,050	2,591	11,794

Table 9

Large Construction Projects

1983 Craft Requirements

48 Hour Week

Craft	Petrochemical Plants	Coal and Steel	Tar Sands Extractions	Heavy Oil Extractions	Alcan Gas Pipelines	Total
Boilermakers	24	35	649	233	-	941
Carpenters	42	6	883	290	171	1,392
Electricians	79	6	1,029	380	233	1,727
Insulators	32	-	45	18	123	218
Ironworkers	42	80	886	308	-	1,316
Labourers	83	16	1,782	578	479	2,938
Millwrights	10	24	113	47	41	235
Operating Engineers	106	20	2,134	689	527	3,476
Pipefitter Welders - Pipefitters	119	36	1,684	642	283	2,764
Sheet Metal Workers	8	-	113	47	-	168
Teamsters	36	9	726	248	276	1,295
Others	15	2	359	108	26	510
Total	596	234	10,403	3,588	2,159	16,980

Table 10

Large Construction Projects

1983 Craft Requirements

40 Hour Week

Craft	Petrochemical Plants	Coal and Steel	Tar Sands Extractions	Heavy Oil Extractions	Alcan Gas Pipelines	Total
Boilermakers	29	42	779	280	-	1,130
Carpenters	50	7	1,059	347	205	1,668
Electricians	95	7	1,234	456	280	2,072
Insulators	38	-	54	22	148	262
Ironworkers	50	96	1,064	370	-	1,580
Labourers	100	19	2,138	694	575	3,526
Millwrights	12	29	135	56	49	281
Operating Engineers	127	24	2,561	827	632	4,171
Pipefitter Welders - Pipefitters	143	43	2,021	770	340	3,317
Sheet Metal Workers	10	-	135	56	-	201
Teamsters	43	11	872	298	331	1,555
Others	18	3	431	130	31	613
Total	715	281	12,483	4,306	2,591	20,376

Table 11

Large Construction Projects

1984 Craft Requirements

48 Hour Week

Craft	Petrochemical Plants	Coal and Steel	Tar Sands Extractions	Heavy Oil Extractions	Alcan Gas Pipelines	Total
Boilermakers	-	18	406	91	-	515
Carpenters	-	3	700	216	-	919
Electricians	-	3	1,888	799	-	2,690
Insulators	-	-	570	294	-	864
Ironworkers	-	41	833	277	-	1,151
Labourers	-	8	1,292	376	-	1,676
Millwrights	-	12	243	104	-	359
Operating Engineers	-	12	1,697	531	-	2,240
Pipefitter Welders - Pipefitters	-	19	3,103	1,305	-	4,427
Sheet Metal Workers	-	-	193	78	-	271
Teamsters	-	4	616	194	-	814
Others	-	1	215	56	-	272
Total	-	121	11,756	4,321	-	16,198

Table 12

Large Construction Projects

1984 Craft Requirements

40 Hour Week

Craft	Petrochemical Plants	Coal and Steel	Tar Sands Extractions	Heavy Oil Extractions	Alcan Gas Pipelines	Total
Boilermakers	-	22	487	109	-	618
Carpenters	-	4	840	259	-	1,103
Electricians	-	4	2,266	959	-	3,229
Insulators	-	-	684	353	-	1,037
Ironworkers	-	48	1,000	332	-	1,380
Labourers	-	10	1,550	451	-	2,011
Millwrights	-	14	292	125	-	431
Operating Engineers	-	14	2,037	637	-	2,688
Pipefitter Welders - Pipefitters	-	23	3,724	1,566	-	5,313
Sheet Metal Workers	-	-	231	94	-	325
Teamsters	-	5	738	233	-	976
Others	-	1	258	67	-	326
Total	-	145	14,107	5,185	-	19,437

Table 13

Large Construction Projects

1985 Craft Requirements

48 Hour Week

Craft	Petrochemical Plants	Coal and Steel	Tar Sands Extractions	Heavy Oil Extractions	Alcan Gas Pipelines	Total
Boilermakers	-	-	140	37	-	177
Carpenters	-	-	376	116	52	544
Electricians	-	-	1,251	340	71	1,662
Insulators	-	-	1,051	503	37	1,591
Ironworkers	-	-	394	93	-	487
Labourers	-	-	706	234	146	1,086
Millwrights	-	-	178	54	12	244
Operating Engineers	-	-	783	195	160	1,138
Pipefitter Welders - Pipefitters	-	-	1,709	342	86	2,137
Sheet Metal Workers	-	-	135	41	-	176
Teamsters	-	-	344	108	84	536
Others	-	-	66	10	8	84
Total	-	-	7,133	2,073	656	9,862

Table 14

Large Construction Projects

1985 Craft Requirements

40 Hour Week

Craft	Petrochemical Plants	Coal and Steel	Tar Sands Extractions	Heavy Oil Extractions	Alcan Gas Pipelines	Total
Boilermakers	-	-	168	44	-	212
Carpenters	-	-	451	139	62	652
Electricians	-	-	1,502	408	85	1,995
Insulators	-	-	1,261	604	44	1,909
Ironworkers	-	-	473	112	-	585
Labourers	-	-	847	281	175	1,303
Millwrights	-	-	214	65	14	293
Operating Engineers	-	-	940	234	192	1,366
Pipefitter Welders - Pipefitters	-	-	2,050	410	103	2,563
Sheet Metal Workers	-	-	162	49	-	211
Teamsters	-	-	413	130	101	644
Others	-	-	79	12	11	102
Total	-	-	8,560	2,488	787	11,835

Table 15

Large Construction Projects

1986 Craft Requirements

48 Hour Week

Craft	Petrochemical Plants	Coal and Steel	Tar Sands Extractions	Heavy Oil Extractions	Alcan Gas Pipelines	Total
Boilermakers	-	-	37	12	-	49
Carpenters	-	-	118	37	104	259
Electricians	-	-	344	107	142	593
Insulators	-	-	509	158	74	741
Ironworkers	-	-	94	29	-	123
Labourers	-	-	237	74	292	603
Millwrights	-	-	55	17	24	96
Operating Engineers	-	-	198	61	320	579
Pipefitter Welders - Pipefitters	-	-	348	108	172	628
Sheet Metal Workers	-	-	43	13	-	56
Teamsters	-	-	109	34	168	311
Others	-	-	10	3	15	28
Total	-	-	2,102	653	1,311	4,066

Table 16

Large Construction Projects

1986 Craft Requirements

40 Hour Week

Craft	Petrochemical Plants	Coal and Steel	Tar Sands Extractions	Heavy Oil Extractions	Alcan Gas Pipelines	Total
Boilermakers	-	-	45	14	-	59
Carpenters	-	-	142	44	124	310
Electricians	-	-	413	128	170	711
Insulators	-	-	611	190	88	889
Ironworkers	-	-	113	35	-	148
Labourers	-	-	283	89	350	722
Millwrights	-	-	66	20	28	114
Operating Engineers	-	-	237	73	384	694
Pipefitter Welders - Pipefitters	-	-	418	130	206	754
Sheet Metal Workers	-	-	51	16	-	67
Teamsters	-	-	131	41	202	374
Others	-	-	12	4	21	37
Total	-	-	2,522	784	1,573	4,879

Table 17

Large Construction Projects

1987 Craft Requirements

48 Hour Week

Craft	Petrochemical Plants	Coal and Steel	Tar Sands Extractions	Heavy Oil Extractions	Alcan Gas Pipelines	Total
Boilermakers	-	-	-	-	-	-
Carpenters	-	-	-	-	52	52
Electricians	-	-	-	-	71	71
Insulators	-	-	-	-	37	37
Ironworkers	-	-	-	-	-	-
Labourers	-	-	-	-	146	146
Millwrights	-	-	-	-	12	12
Operating Engineers	-	-	-	-	160	160
Pipefitter Welders - Pipefitters	-	-	-	-	86	86
Sheet Metal Workers	-	-	-	-	-	-
Teamsters	-	-	-	-	84	84
Others	-	-	-	-	8	8
Total	-	-	-	-	656	656

Table 18

Large Construction Projects

1987 Craft Requirements

40 Hour Week

Craft	Petrochemical Plants	Coal and Steel	Tar Sands Extractions	Heavy Oil Extractions	Alcan Gas Pipelines	Total
Boilermakers	-	-	-	-	-	-
Carpenters	-	-	-	-	62	62
Electricians	-	-	-	-	85	85
Insulators	-	-	-	-	44	44
Ironworkers	-	-	-	-	-	-
Labourers	-	-	-	-	175	175
Millwrights	-	-	-	-	14	14
Operating Engineers	-	-	-	-	192	192
Pipefitter Welders - Pipefitters	-	-	-	-	103	103
Sheet Metal Workers	-	-	-	-	-	-
Teamsters	-	-	-	-	101	101
Others	-	-	-	-	11	11
Total	-	-	-	-	787	787